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ELECTRICAL WORLD

ELECTRICAL PRICES HAVE MOVED TOWARD STABILIZATION

Generally up. Volumes low. Profits slim. Differentials less

WISCONSIN MUNICIPAL DIESELS SHOW POWER COSTS

Official figures reveal unit costs from 1.6 to 3.4 cents

GAPS AND GRADING RINGS FORTIFY AGAINST LIGHTNING

Trussed wood arms and ground wires give wood line protection

GROUND FAULT CURRENT TRIPS RURAL FEEDERS

Spring-stored energy found advantageous for tripping

GIVE THE RIGHT MOTOR THE CONTROL IT DESERVES

Both selections equally important in fitting drive to load

UTILITY POWER STATISTICS STILL SHOW GAINS

Kilowatt-hours ahead of 1933, earnings ahead by 5 per cent

VIRTUES OF RANGE LOADS JUSTIFY COSTS OF MEETING THEM

One system found ample for range load it could sell

July 28, 1934

TWENTY-FIVE CENTS PER COPY—McGRAW-HILL PUBLISHING COMPANY, INC.

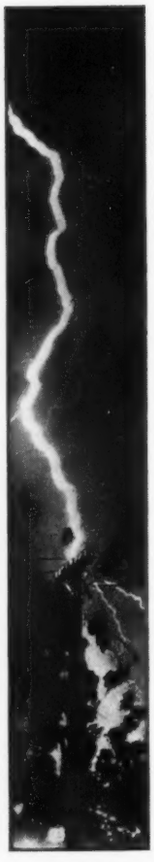
WEEKS WITHOUT RAIN—
HOW'S GROUND RESISTANCE?

Where high resistance is encountered — or is expected as in times of drought — install Murray Hollow Copper Ground Electrodes. Resistances can be reduced to 25% of their original values — and resistances thus regulated mean that lack of precipitation will not affect the path to ground.

HIGH RESISTANCES UNNECESSARY

If ground resistance is abnormally high the efficient operation of protective equipment is difficult.

Electrode length is based on depth of the permanent moisture level.



Treating solutions should be at the permanent moisture level, also. That's where they last the longest and do the most good.

BE CONSISTENT

These Murray Electrodes consist of copper tubing — perforated with holes near the base. We make the tubing of copper because it is "The Everlasting Metal." Treating solution which is poured or pumped into the tubing, passes through the holes and impregnates the surrounding soil — at the permanent moisture level.

Imbedding of the tubing is effected with a uniquely designed Driving Rod and Weight. The tubing is fitted with a Driving Point.

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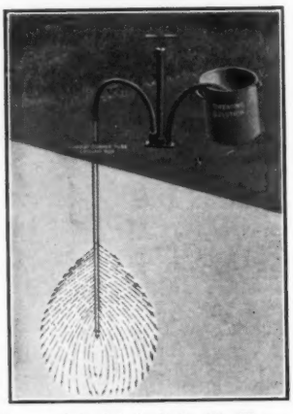

METROPOLITAN DEVICE CORPORATION

METROPOLITAN DEVICE CORPORATION, Brooklyn, N. Y.

Please send Ground Electrode Booklet, Charts and Price Sheet

Name.. .....

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Company.....

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ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

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Reader's Guide to This Issue

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THE INDEX is merely a convenient guide. Many articles will appeal to several reader groups—many will apply to all. News and other departments are of general interest.

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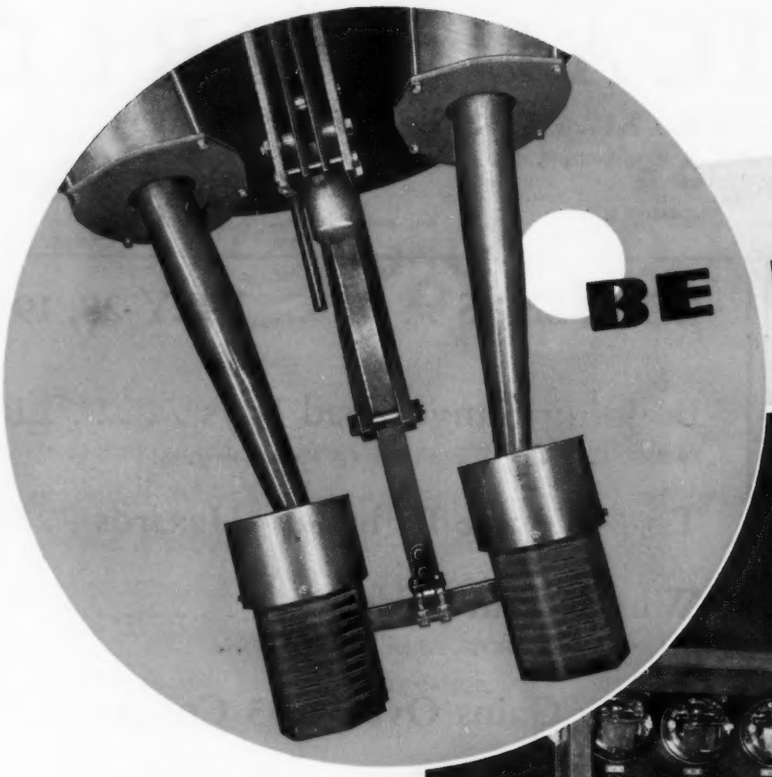
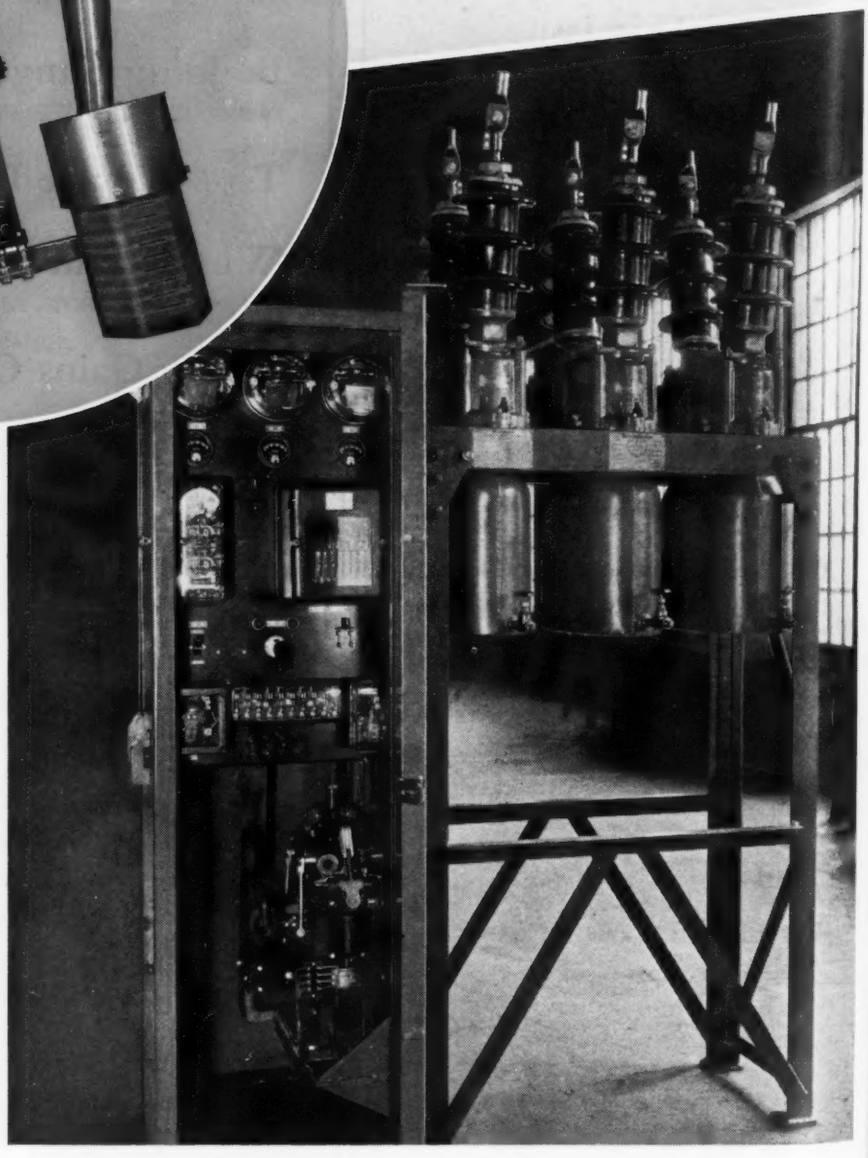


BE PREPARED



Only "De-ion Grids" and new contacts are needed to revamp your old Westinghouse Oil Circuit Breakers. No new mechanical parts are required. The complete change-over can be made at low cost and in only a few hours' time.

Westinghouse first developed instantaneous reclosing Oil Circuit Breakers in 1931. The above 15-kv. "De-ion Grid" breaker is one of a large number that have been built with the instantaneous reclosing feature. This breaker is equipped with all necessary relays, a solenoid, Rectox device, and bushing current transformers for a complete small substation.

Old Westinghouse circuit breakers, in addition to being revamped with "De-ion Grids," can also be equipped for instantaneous reclosing service.

ELECTRICAL WORLD

Established 1874—McGraw-Hill Publishing Company, Inc.

for the Week Ending

July 28, 1934

L. W. W. MORROW, *Editor*

McCulloch Specifies the Ideal Holding Company

Utility men will read with interest the specification of C. A. McCulloch for the ideal holding company. He generalizes, of course, from his experience as a receiver for Middle West Utilities, but his major conclusions are sound and point the way to holding company developments. There are good and bad holding companies, but the very name is in public disrepute and many electrical men question its merits. Yet the holding company is necessary and serves a legitimate function in the utility industry.

Only stock securities, approved management fees, no construction subsidiaries, no intermediate companies, operating executives on the board, a few men at headquarters to establish consistent management and financial policies, all possible responsibility on operating executives—these are cardinal principles stated by Mr. McCulloch. As ideals these are sound, but as practical features they are difficult to apply to the many types of existing utility holding companies. Securities are already issued, intermediate companies are now necessary to conform to law or to security issue provisions and past management policies already have been carried out to form the working organizations. Changes in the *status quo* cannot be made instantly and should not be made unless they are in the public interest. All holding company managements, however, are working to change their organizations and policies to meet new conditions to better advantage. Their problems are many and difficult.

Action is slow necessarily, but some steps can be taken quickly. The best first step is to put operating property executives on the holding company boards. Their ideas are good and they will serve better if they are more familiar with the holding company problems. Another principle to follow is that of decentralization of authority and the staffing of operating properties with competent and responsible men in key positions. Still another logical move is to eliminate construction subsidiaries, for there is not sufficient work in sight to warrant their existence.

Many of the principles stated by Mr. McCulloch are being adopted and the holding company is not a laggard in conforming to his specifications. Unfortunately, much of this good work is done quietly and is not known by the industry or by the public. The holding companies are following the old adage "by their works ye shall know them." Possibly that is not a good principle to follow too literally in these days of publicity.

Penny Politics in Ontario

The new Hydro-Electric Power Commission is cleaning house in a typically political manner. It rode into power on the "Abitibi deal" but not content with this it is firing 48 employees on the plea of cutting costs. F. A. Gaby, chief engineer and the man who is responsible for the splendid engineering on the system, was dismissed; while 46 other employees getting over $5,000 a year were served notice of dismissal with the option of remaining at their tasks at such salaries as the Commission might pay them.

These men are the key engineers and operators of this large system. They have worked hard to build and operate the system and have played no part in politics. Their scale of pay was relatively low for the positions occupied. Now after years of competent and conscientious service they get typical pennywise political treatment.

This enterprise was built by Gaby, Brandon, Don Carlos, Jeffery, Hogg and others who devoted their talents conscientiously to constructing and operating the system and left politics to the Commissioners. Now they reap this political

reward. What other evidence is needed of the evils of political control of utilities? And what will become of this splendid system if it is placed in the hands of incompetent engineers and operators? No matter whether the former Commissioners were guilty or not guilty in the "Abitibi deal," this political flagellation of conscientious and competent employees is unjust and unfair.

Price—Volume—Profits

An interesting analysis of price changes is printed in this issue. This is important from the point of view of the significance of prices on business volume and profits. The government started last year by giving increased wages and increased employment in industry on the plea of both reform and recovery. Increased wage costs, taxes* and code organization costs forced electrical and other manufacturers to increase prices nor did purchasing volume increase quickly.

In recent months, however, the volume of business has been increasing steadily despite higher prices, but the government is now after volume and is putting pressure on industry to lower prices in order to get business volume. In electrical manufacturing the volume of business is still subnormal in all lines but appliances and, despite higher prices, profits are low or entirely absent. Granted that present prices are too high for a large volume of business, how can the manufacturers afford to lower prices to induce greater sales after several years of deficits? Looked at broadly, increased wages, increased taxes and increased costs of operation face electrical manufacturers and present price levels are apt to be maintained and even elevated in the coming months. Fair profits are more important to business recovery than below-cost prices.

But a study of some of the price changes shows inconsistencies and increases out of line with increased costs. It is apparent that some manufacturers and some departments have used the code cloak to advance prices beyond reason, if it is assumed that prices in previous years were fair. This was to have been expected, but should not cause concern. Out-of-line prices will not exist long. More competition and no sales will force adjustments to logical levels. And on the whole, the code privileges have not been abused. Prices in themselves are not of great importance in the electrical industry because of the enormous unsold markets. These are not price-conscious markets. They are markets that must be sold the electrical idea and the electrical way of doing things.

Facing the Facts on the American Home

Advance figures from 50 cities are now available from the Government's Real Property Inventory. They should be profoundly interesting to power company men. For here is an accurate report on the present condition of the homes of America in the matter of modern equipment for comfort and health. It is to some extent a measure of the need that exists for electric service.

In these first 50 cities, located in 38 states, are 1,026,000 dwellings, with a population of about 4,000,000. Only 5 per cent of these residential structures were built within the past 5 years and over 62 per cent need repairs. Some 7 per cent are vacant but 7 per cent have extra families doubling up. So there is no surplus housing. Eighty per cent rent for $30 a month or less. Over 20 per cent have no electric light, 21 per cent no toilet, 27 per cent no bathtub or shower, 56 per cent no central heating, 84 per cent no mechanical refrigeration and 57 per cent no gas or electric range. The electric ranges total only 3 per cent. Fifty per cent have no hot water and 10 per cent no running water at all.

Now these are typical American communities, averaging 20,000 homes each, with no big cities, no rural towns. They represent the domestic consumers of the power industry. They indicate the market situation in which the utility companies must do their selling, if they are to meet the present pressure for lower rates and higher taxes, by increasing the revenue from residence customers and improving the load factor.

A few companies, of course, have already made their own local inventories of electrical equipment now in use in the home. Most of them, however, have no definite knowledge of what their consumers actually need nor what they can afford to spend. Yet this, after all, is the key to the whole problem. The power companies will eventually sell themselves out of their difficulties. But they will do so only through making their service procurable to their customers. These facts on present household equipment, therefore, show not only the size of the unsold market but the conditions that must be faced in developing it.

Range Load Benefits Overbalance System Costs

By A. B. HIRD
Iowa Electric Light & Power Company, Cedar Rapids

The natural high diversity factor of range load has long been known. Now comes the discovery in Cedar Rapids that a distribution system capable of handling the Monday morning clothes washing load can also carry as high a range load as can readily be sold. It proves again that domestic cooking business abundantly repays the cost of selling it. Here is the basis for a comparative study in any city that has not yet begun the serious development of range load.

BETWEEN the years 1924 and 1932 several hundred ranges were installed on the Cedar Rapids city distribution system. Early in 1932, because of the decreasing system load, it became apparent that intensive load-building promotion was necessary. Experience with installed ranges had shown in a general way their revenue-producing qualities, and it was decided to make a study to put the results of this experience on a foundation of locally collected facts. One section in the city of Cedar Rapids, supplied by one transformer secondary system, had connected on January 1, 1933, nine electrical ranges out of a total of 42 consumers, or a 21 per cent range saturation. This district represented a saturation approximately, if not in excess of, the most optimistic estimates of the commercial department, and therefore was selected as a test district.

A temporary secondary circuit was installed to which the nine range consumers were connected. All other consumers were left on the original secondary. Graphic wattmeters were then placed at the transformer terminals, one on each secondary. These instruments recorded the demands of the nine range consumers on one chart and the 33 other consumers on the other. The total load curve was made by combining the two charts. The three load curves for a seven-day period thus secured, but too large for satisfactory reproduction here, have been summarized in Table I.

In addition instruments were installed on the individual services of the nine range consumers to secure data to plot individual consumer load curves. These curves also are impracticable to reproduce here and are expressed in figures in Table II. No attempt was made on these load curves to differentiate between the normal residence and range loadings. Thus it is necessary in a study of the maximum range demands to consider that the demands as shown are the result of range demand plus the average residence demands occurring at the same time.

Table I shows the relation of demand and time of demand of each load; that is, range consumers and consumers without ranges, to the total load of the district under test. It will be noted that the maximum demands of the two types of loads, nine range installations and 33 non-range installations, show approximately the same daily maximum demands with the exception of the Sunday demand. The maximum range demand occurred on a Sunday between the hours of 9 a.m. and 1:30 p.m., with the peak demand, 13.5 kw., occurring at 11:30 a.m. The lighting demand at the time of the maximum range demand—that is, between the hours of 9 a.m. and 1:30 p.m.—averages approximately 2.4 kw. The data tabulated were taken during the week of Saturday, March

Table I—Time Separation of Peaks Between Customers With and Without Ranges

	Daily Peak Loads		Evening Peak Loads†	
	Maximum Demand,* Kw.	Time of Occurrence	Maximum Demand,* Kw.	Time of Occurrence
Sunday				
9 range customers....	13.5	11:30 a.m.	6.8	4:15 p.m.
33 no-range customers	7.8	7:15 p.m.	7.8	7:15 p.m.
Total 42 customers...	15.2	11:30 a.m.	11.2	7:15 p.m.
Monday				
9 range customers....	10.4	6 p.m.	10.4	6 p.m.
33 no-range customers.	8.2	8:15 a.m.	7.3	7 p.m.
Total 42 customers..	15.1	7 p.m.	15.1	7 p.m.
Tuesday				
9 range customers....	8	7:15 a.m.	8	6 p.m.
33 no-range customers.	8.4	7:30 p.m.	8.4	7:30 p.m.
Total 42 customers..	13.5	7:30 p.m.	13.5	7:30 p.m.
Wednesday				
9 range customers....	8.4	5:15 p.m.	8.5	5:15 p.m.
33 no-range customers..	9.7	7 p.m.	9.7	7 p.m.
Total 42 customers..	13.2	6:45 p.m.	13.2	6:45 p.m.
Thursday				
9 range customers....	8	7:15 a.m.	8	6 p.m.
33 no-range customers.	8.4	7:30 p.m.	8.4	7:30 p.m.
Total 42 customers..	13.6	8:30 a.m.	13	7:15 p.m.
Friday				
9 range customers....	8.8	6:30 p.m.	8.8	6:30 p.m.
33 no-range customers.	8.4	7:30 p.m.	8.4	7:30 p.m.
Total 42 customers..	13.2	6:30 p.m.	13.2	6:30 p.m.
Saturday				
9 range customers....	10.5	6:15 p.m.	10.5	6:15 p.m.
33 no-range customers.	8.4	7:30 p.m.	8.4	7:30 p.m.
Total 42 customers..	14.3	6:15 p.m.	14.3	6:15 p.m.

*To nearest quarter hour and to nearest tenth as read from load curve. †After 4 p.m.

11, 1932, to Tuesday, March 17, 1932, inclusive. Excluding the Sunday demand, it will be noted that the range peak during this period occurred about one hour and fifteen minutes ahead of the lighting peak or at approximately 6:15 p.m.

It was determined by tests that the time of the maximum daily range demand occurs at practically the same time throughout the year. The time of the lighting peak demand varies according to seasons, these periods of maximum daily lighting demand occurring approximately one hour and fifteen minutes after sundown. In order to determine the time relation between the maximum lighting and range demands time-demand curves were plotted for the period between October 1 and April 1. These curves show the relative time of maximum range demand, the time of maximum lighting demand, the time of maximum system demand and the hour of sunset for the stated period.

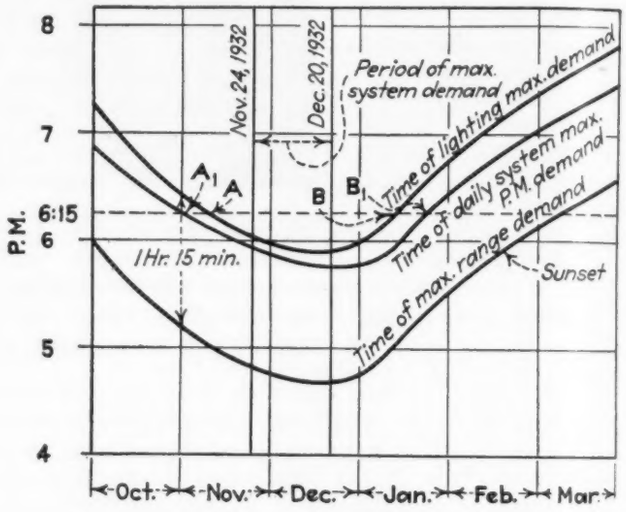
The most important question which arises is in regard to the average demand and diversity of range loads. It is a known fact that one range installation may be made to appear in an unfavorable light and also that only a few ranges result in a comparatively large average demand. From the weekly load curve, earlier mentioned, the average range demands were determined and appear as the maximum daily and average demands for the nine ranges under test in Table III.

Maximum occurs Sunday forenoon

IT WILL be noted that the maximum average demand of 1.5 kw. occurred at 10:30 a.m. on a Sunday. The other daily maximum average range demands approximate 1.00 kw. per range. Due to the impossibility of a test on a large group of ranges, use of published data was made to determine average demand data for from one to 5,000 ranges. Such data were secured from the report of the domestic cooking and water heating committee of the N.E.L.A., published in the proceedings of the 1926 national convention. These data show that a few ranges result in a comparatively high demand, but when the number of simultaneously served installations passes 30 the average demand drops to about 1 kw. and that the curve flattens out so markedly that the average demand for 100 ranges is about 0.88 kw. and for 5,000 ranges about 0.7 kw. The highest average maximum demand of 1.5 kw. secured in the Cedar Rapids study agrees with these data.

The individual demands (Tables II and III) show the relatively high diversity of range loads even in small groups such as the nine ranges on which the Cedar Rapids test was run. The diversity factor of this group was determined to be approximately 2.5, which is about equal to the diversity factor for ten ranges, as shown by the committee report.

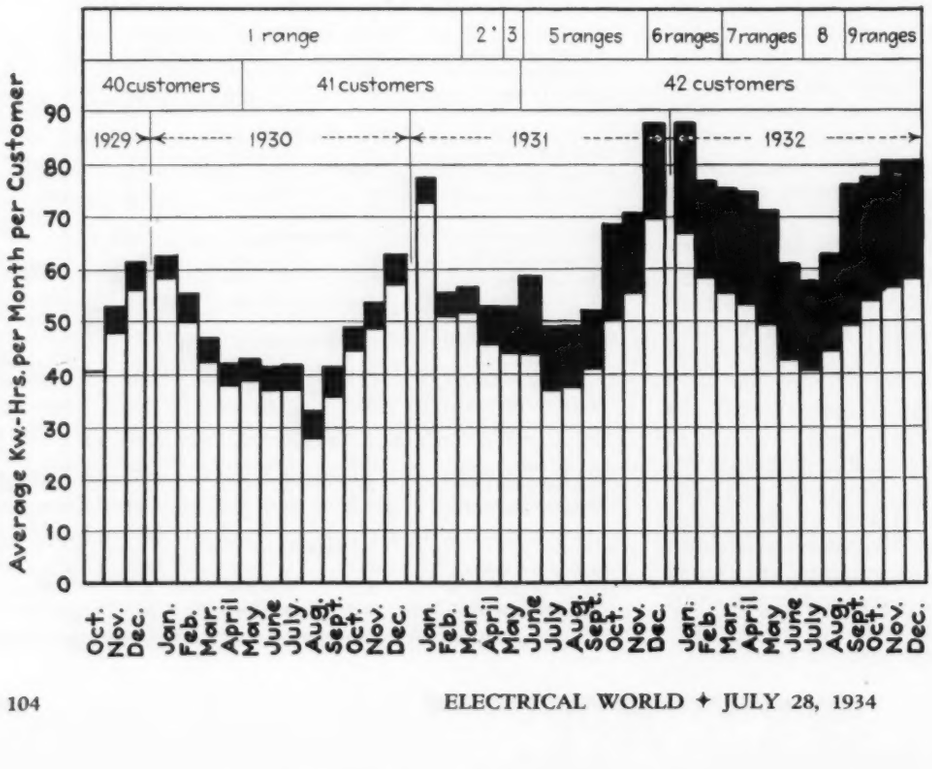
In addition to the study of the effect of demands and diversity on the distribution system a study was made



Time relation of range and lighting demands

There are two points of coincidence between the range and lighting demands, "A" and "B," they occur the second week of November and in the third week of January respectively. Between these two periods the range demands occur after the lighting peak, with a maximum lag of approximately one-half hour. Referring to the time curve for system peak demands, it will be noted that the time of system maximum demands at all times occur before the time of maximum lighting demand. The times of coincidence between the range and system demand occurring at points A_1 and B_1 are at approximately November 1, and January 21, respectively. In order to compare the above time demand curves with the period during which the system demand is at a maximum two limit lines were plotted, November 24 and December 20.

During the system peak period coincidence between the periods of maximum range demand and maximum lighting demand does occur, but the range peak at no time exactly occurs with the lighting peak, and the heaviest portion of the range load is over before the bulk of the evening lighting comes on. The same conclusion is applicable to the system demand, only more favorable, due to the difference between the time of the maximum system and the time of maximum range demand.



Effect of ranges on average consumptions

The blocked upper portions of the columns show the average increase in monthly usage per customer caused by the growing number of ranges.

of the kilowatt-hour consumption and the revenue derived from the area under test. This study consisted of making a tabulation of kilowatt-hour consumption and revenue for twelve months of each year from 1927 to 1932, inclusive. From this compiled data the effect of ranges on the average consumption was determined. The results as secured are shown. The graph shows the total number of consumers served, the number of range installations and the average kilowatt-hour consumption per consumer for each month for a period of six years. The graph of average kilowatt-hour consumption per month shows by the blank portions the average consumption of consumers in the study excluding range kilowatt-hour consumption. The top or blocked portions of the columns show the parts of the total average consumptions which are due entirely to the electric range. This graph clearly shows the general increasing trend in average residential consumption and also the way this trend is accelerated by the electric range. In addition to the actual results shown on the usage graph it was determined that the average range consumes approximately 1,400 kw.-hr. per year, or about three times the amount used in the average residence.

Table II—Range Diversity—Fifteen-Minute Loads, All Uses, for Nine Range Customers
(From 6 a.m. to 8 p.m.)

	Loads (Watts) per Customer								
Time a.m.	1	2	3	4	5	6	7	8	9
6:00	100	0	1,000	300	0	300	1,000	400	200
15	100	0	150	300	0	0	2,500	250	0
30	450	0	150	100	0	0	0	250	200
45	450	0	150	100	0	0	300	0	0
7:00	150	0	250	1,000	100	0	200	0	200
15	450	100	250	150	100	0	100	0	0
30	100	100	250	100	400	0	100	0	0
45	100	100	150	100	3,350	0	200	1,500	0
8:00	100	500	150	1,000	400	0	300	2,100	100
15	100	500	0	0	1,000	0	100	1,900	0
30	100	100	0	100	3,500	0	100	100	150
45	100	100	3,850	100	3,500	0	200	250	0
9:00	100	100	3,850	150	3,500	0	200	600	150
15	100	100	3,850	150	3,500	250	0	600	0
30	100	0	3,800	100	3,500	250	0	400	1,500
45	100	0	3,900	1,250	200	250	200	200	1,200
10:00	100	0	3,900	1,250	1,050	400	1,000	0	1,200
15	100	0	500	1,250	1,050	0	1,000	0	100
30	100	0	750	1,250	100	0	150	250m	300
45	100	0	100	100	100	0	0	250	300
11:00	100	100	250	200	100	0	0	200	1,400
15	100	100	250	200	0	0	0	200	300
30	100	100	100	100	0	0	0	0	300
45	100	100	100	2,200	0	0	0	2,200	300
Noon p.m.	100	100	250	1,500	100	0	0	2,200	300
12:15	700	100	1,200	100	100	0	0	2,650	300
30	1,750	100	500	150	100	0	100	1,800	300
45	1,750	100	250	0	100	0	900	2,650	500
1:00	100	100	260	0	100	100	1,100	100	1,850
15	100	2,750	250	0	100	100	1,100	100	1,200
30	100	1,800	1,250	0	100	100	1,100	100	150
45	100	2,100	500	0	100	200	0	450	1,200
2:00	100	100	250	0	100	200	0	250	1,500
15	100	450	250	100	100	1,800	0	250	1,600
30	100	100	250	150	0	1,600	100	0	0
45	100	100	250	100	0	800	0	0	0
3:00	100	100	250	100	0	600	100	0	0
15	100	100	250	100	0	100	100	0	0
30	100	100	250	100	0	0	100	200	200
45	100	100	250	100	0	0	0	200	0
4:00	100	100	250	500	0	0	200	200	200
15	100	100	400	100	0	0	300	0	0
30	100	100	400	100	100	0	100	200	0
45	100	100	250	100	100	200	100	200	1,000
5:00	100	2,750	250	100	3,400	200	100	200	2,850
15	100	2,000	250	100	100	200	3,400	200	300
30	100	2,200	250	100	3,400	200	4,400	200	1,100
45	100	1,000	400	150	100	100	3,400	0	500
6:00	100	100	1,500	2,000	100	100	3,400	0	600
15	100	100	1,750	1,000	200	100	3,400	0	1,000
30	100	100	1,750	1,000	200	100	3,600	200	300
45	100	100	300	300	200	800	4,800	200	300
7:00	100	100	500	300	300	400	200	400	300
15	1,450	100	500	300	300	800	100	500	100
30	1,450	100	500	200	300	500	100	100	200
45	1,450	100	150	350	300	500	200	0	300
8:00	200	100	300	350	200	500	200	0	300

Table III—Daily and Average Demands
Nine Ranges

Day	Maximum Demand, Kw.	Average Demand, Kw.	Time of Occurrence
Sunday	13.5	1.5	10:30 a.m.
Monday	10.2	1.13	6:00 p.m.
Tuesday	8.1	.90	6:00 p.m. and 7:15 p.m.
Wednesday	8.1	.90	11:45 a.m.
Thursday	8.4	.93	6:00 p.m.
Friday	8.8	.98	6:30 p.m.
Saturday	10.4	1.15	6:15 p.m.

Certain primary facts regarding the load characteristics of electric ranges may be stated:

A. Effect on distribution system.

1. That the cooking peak demand at no time exactly coincides with the maximum lighting peak.
2. That while a few ranges result in a comparatively high demand, yet when the number of simultaneously served ranges passes 30 the average demand drops below 1 kw. per range.
3. That the electric range load has a high diversity factor.

B. Effect on distribution system and revenue.

1. That with the number of installed ranges simultaneously served being 30 or above, with an average maximum demand of 1 kw. or less, with an annual consumption of 1,400 kw.-hr., one range installation is equivalent to three ordinary residence consumers with an average demand of 350 watts each and with a corresponding kilowatt-hour consumption of approximately 500 per year.
2. That an increase of kilowatt-hour consumption in the average residence of 300 per cent is worth serious consideration in the load-building program.

Washing machine kva. exceeds range

CONSIDERING the range load curve in comparison with washing machine motor loads, the load curve for Monday between 8 a.m. and 9:30 a.m. shows a demand of approximately 8,000 watts for the 33 consumers without ranges. This load is known to have a relatively poor power factor, for practical purposes approximately 65 per cent, making the resulting kva. demand of the washing machine load approximately 12.3 kva. The Monday morning washing machine demand and the maximum demands of the range load, which is practically non-inductive, are therefore on a comparable basis in terms of kva. demand.

It was noted that the computed kva. demand of the washing machine load was, with the exception of the Sunday morning range demand, in excess of any range demand occurring throughout the period of the test. This conclusion was substantiated by the record from a graphic voltmeter on the secondary terminals of the transformer supplying the district under test. During the entire period of the test, with the exception of the Monday morning load, the voltage regulation at the transformer terminals was constant between 2½ per cent above or below 115 volts. The Monday morning voltage was the only period in which the voltage regulation was below these limits.

And in conclusion, it is to be noted on the usage graph that from November, 1929, to March, 1931, only

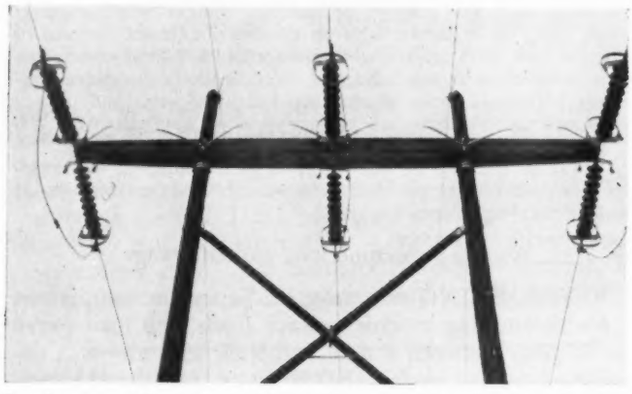
one range was served in the district under test. This range was purchased and installed by an employee of the company. And it may be stated that seven of the eight additional ranges installed between March, 1931, and January 1, 1933, were sold and installed from the promotional efforts of that one employee. This employee was not connected with the sales department. Should it not be concluded that one range in a district is of value in electric range promotion, particularly if that range is owned and installed by a utility employee who has confidence in the future of the utility business and is willing to make a small amount of promotional effort?

Prepared Against Lightning

Thin trussed-wood crossarms with special gaps, double grading rings on strings and overhead and buried ground wires are expected to give good protection against direct lightning strokes

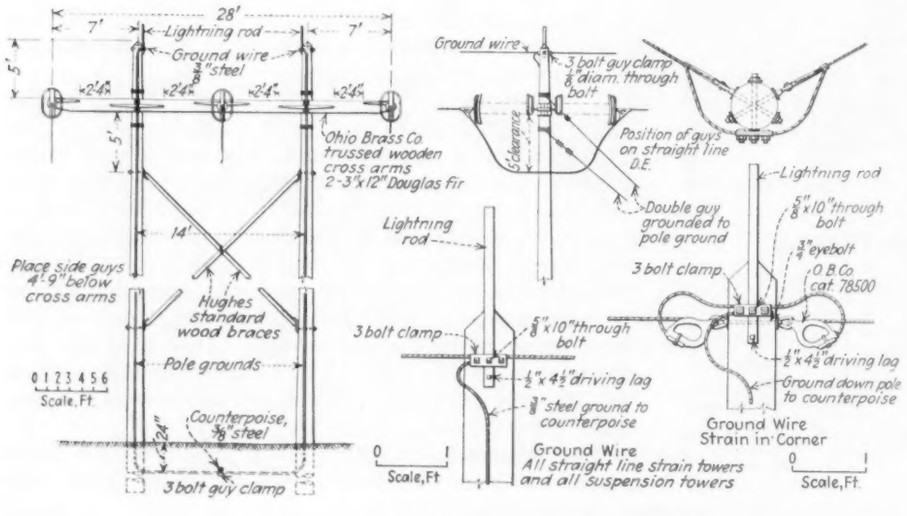
TO PROVIDE emergency transmission service into the Pittsfield, Mass., district in case of trouble on the double-circuit line feeding energy to the city from the Cabot station, near Turners Falls, the engineering department of the Western Massachusetts Companies has completed a 115-kv. tie line between the New England Power Company system at Lanesboro and Pittsfield. This tie includes a single-circuit wooden-pole section 6.6 miles long, of H-frame design, and to minimize lightning hazards special consideration was given to spacings, fittings and grounding facilities.

The spans average 400 ft. and the conductors are No. 4/0 A.C.S.R., with two $\frac{3}{8}$-in. steel ground wires carried between pole tops and grounded by stranded steel cable of the same size down each pole to a buried counterpoise laid 2 ft. below the earth surface and running parallel to the longitudinal center of the line. The poles are of Western red cedar, normally 50 ft. long, and the crossarms are of Ohio Brass trussed design using Oregon fir and 28 ft. long on both straight line and strain construction. Conductors are supported 33 ft. above ground at suspension towers and 38 ft. above earth at dead ends. The minimum clearance of the conductors above ground between towers is 23 ft. 6 in. and the standard conductor spacing is 14 ft. between phases. Nine-disk Locke insulators are used in suspension and ten-disk insulators in strain construction. Lightning rods 2 ft. long are installed at the pole tops.

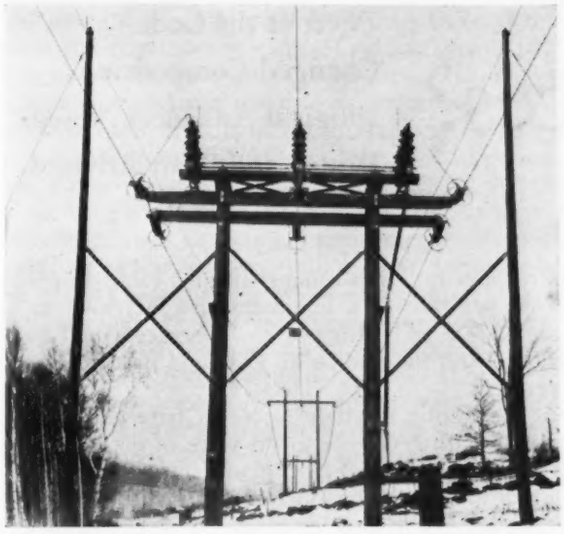


Strain tower has connections from overhead ground wires down poles to counterpoise, jumper loops, truss type crossarms and crossarm horn gaps

Protection of the line against direct stroke damage is a main feature of the design. The keynote of the design is the provision for carrying the discharge from the ground wires down the poles to the counterpoise ground and dissipation of the remainder of the energy wave along the ground wires in each direction. The power conductor is insulated from ground by the gap across the insulator string plus 2 ft. 4 in. of air space in the crossarm gap. Ohio Brass crossarm gaps are installed on both straight line and strain towers and grading rings are used on all power insulators. Half-round grading rings equipped with corona balls are used on strain insulators at points where it is desirable to maintain maximum clearance between the bottom of the ground ring of the insulator string and the jumper loop. Crossarms are purposely made thin, the thickness being 2 in.



Elevation of strain tower with details of wire spacing and grounding arrangements



Switching tower showing assembly of insulators, crossarms, diagonal braces and conductors

and the height 12 in., to allow trussed arm formation. On straight suspension and strain construction the distance from the power conductor to the nearest pole ground is 7 ft. Hughes diagonal wooden braces are used in general in place of side guys. With two thin crossarms, if one should be destroyed the remaining arm will still support the line.

Crossarm gap for lightning jump

It is expected that in the rare cases when lightning will discharge to the grading ring this will take place along the crossarm gap, and that after passing from ring to ring it will be dissipated by attenuation along the power conductor in each direction from the tower. On straight suspension the length of the gap across the insulator string is 45¾ in. and the total ring gap plus the crossarm horn gap is 73¾ in. Under a wind velocity of 30 m.p.h. the minimum distance from the power conductor to the pole ground connection with a 20-deg. swing of the insulator is 54 in.

Near the New England Power tap an installation of General Electric air-break switches equipped with Hughes operating arm has been erected on a structure of six poles with double crossarms, insulator and diverter wires as illustrated. Wooden diagonal braces were effectively used here instead of guys, with the exception of side guys for the outer poles. These last are 65 ft. long and the entire structure forms an unusually rigid design.

Effect of Water Heating on Rate Paid

A study of 150 customers in Boston shows the interesting influence of water heating load upon the cost of service to large and small families.

It is obvious that the use of electric water heating on a promotional rate basis will greatly reduce the average price paid for electricity by the householder. But it is not always realized that this service probably does more to put such customers in a uniform zone in cents per kilowatt-hour than any other yet developed on a considerable scale. It was shown in the ELECTRICAL WORLD, May 12, 1934, page 700, that in the case of 100 residential customers of the Boston Edison Company using water heating over a period of at least a year a reduction of 45 per cent in the average price paid for electricity resulted for domestic applications of energy. This survey has been extended to cover 150 such customers. The data include the number of rooms occupied and the number of persons in the family of each customer in addition to area statistics.

The regular residential "B" rate is 7.5 cents per kilowatt-hour for the first 2 kw.-hr. per 100 sq.ft. of floor area, 5 cents per kilowatt hour for the next 70 and 3 cents per kilowatt-hour for the excess. Minimum area 1,000 sq.ft. The water heating or "L" rate is 3 cents per kilowatt-hour for the first 25 kw.-hr. consumed per month and 1 cent per kilowatt-hour for the excess. The rate is off-peak. Lamp renewal service is covered in rate "B" (average 2.7 mills per kilowatt-hour).

The average results of the year's service to the 150 customers are closely comparable to those previously published. However, it is of much interest to note that the average rates obtained for the total household service in particular cases vary widely and without doubt from many causes. The average price per kilowatt-hour paid by families with two persons in each was 2.5 cents, families with four persons paid 2.34 cents and those with six members paid 2.23 cents. These averages reflect the increased usage of electric service by larger families, but only on the average. Many cases occurred where smaller families used more electricity than larger ones and where homes with larger floor areas used less energy than the smaller domiciles. The varying conditions controlling usage of service are responsible for the integrated energy consumption of each customer during the year, and the promotional character of the rates naturally rewards those who use the service most.

Little conflict over average rates

Probably the most striking point is that water heating adds so much to the annual energy usage of the home and on such favorable terms per kilowatt-hour that it, in a sense, democratizes the service. This is done so effectively that there is little ground for complaint between different customers as to the averages which they respectively earn. Putting it in another way, the two-members-per-family customers paid only 1.6 mills more per kilowatt-hour for their total service than did the families with four members and only 2.7 mills more than the six-person families.

The differences are far greater as to average rates paid for other than water heating service. Therefore electric water heating is a stabilizing factor in over-all household rates. It brings down the average for all usage in the home to a range of prices where very liberal usage is remarkably low in cost; also, it levels off many peaks of comparison between different homes and puts all but a very few into a price band which is narrow and low enough to carry but little political interest on fair bases of comparison.

What About Prices?

Effect of the Code?
Changed Competition?
Illogical Advances Noted.
Watch and Wait Advised.

By L. W. W. MORROW
Editor *Electrical World*

WHAT has the NRA done to prices in the electrical industry? In general, all prices have increased and the current opinion is that further increases may be expected. A large amount of present buying is predicated upon this opinion.

But have prices increased beyond reason and has NRA changed buying and selling practices for the better? Are price agreements more prevalent? Are differentials and discounts changed to give a better deal for the large manufacturer, the small manufacturer and the purchaser? No one can answer these questions conclusively for two reasons. The first is that all facts are not known and the second is that business is still in a state of flux with respect to both its volume and the effect of the codes on prices and practices.

First grant that all buyers and all sellers wish to do business on a fair profit basis. Next grant that during the depression the volume of business was so small that few if any manufacturers could make a profit at any price and, therefore, in the desperate year of 1932 they slashed prices too greatly in their scramble for the insignificant business that was available. With the coming of NRA, accompanied by an increase of business volume, an increase of prices could have been expected both through getting back to a condition of better stability and because of increased costs necessitated by code requirements. Thus if 1931 prices were nominal and reasonable, prices dropped to abnormal levels in 1932 and then started up in 1933 and made be expected to increase somewhat in the future unless the business volume increases greatly.

An investigation based upon actual purchases made by utilities in several parts of the country has been made to find the facts about the price changes since 1931. This investigation covered all supplies and equipments purchased, both electrical and non-electrical, and the accompanying tables show the price changes measured from 1931 to about April in 1934. These data and the percentages given are not exact for any locality or for any property and are significant only as general indicators.

Prices of some products, such as meters and transformers, remained quite stable during 1932 and then increased 8 to 10 per cent in the past six months. In other instances, such as tape, 1932 found a demoralized price situation, which has been followed by a rapid and apparently abnormal price increase. Wire and cable fluctuations are also interesting. Base copper prices dropped about 50 per cent in 1932 and came back to the present 80 per cent value as compared to 1931. Low-voltage and rubber cable dropped to 60 per cent and then rose to 106 per cent in the middle of 1933, where it has remained. High-voltage shielded cable dropped to about 80 per cent as a minimum and increased to 115 per cent. BX cable dropped to 73 per cent and took a jump to 113 in the middle of 1933 and has increased to 123 per cent.

It is interesting to study prices of bare and weatherproof wire with reference to the price of copper and the relative spread allowed for manufacture. It will be noted that this spread has increased from 1.75 to 4.0 and that the prices have also increased. It yet remains to be determined what the effect of non-Blue Eagle copper will have on the base copper price. It should be quite appreciable.

Prices for large electrical apparatus have increased very little and sales have been few. On the other extreme, prices of appliances in general have increased from 10 to 30 per cent, with, of course, exceptions, such as the electrical refrigerator and the recent influence of the T.V.A.

A study of these price changes permits of no valid conclusions as to whether prices are too high or too low. Electrical manufacturers, in general, are not making a profit on the present volume of business, but could make a good profit at these prices if a normal volume of business were available. There is no profit in job-lot orders of wire, cable or other equipment, which must be set up as a special production job for each order. On the other hand, it is not evident that lower prices would stimulate buying; on the contrary, much of the present buying is based upon anticipations of further price increases.

Under present utility operations prices of fuel and

Table I—Increase in Prices of General Supply Materials Since 1931

	Per Cent		Per Cent
Cement	4–15	Auto tires	30–60
Paint	10–15	Shovels	5–11
Rope	5–10	Steel valves	20–30
Gravel	6–30	Brass valves	20–30
Grit	15–25	Brick	5–10
Sand	10–20	Packing	5
Steel bars	10	Nails	8
Structural steel	10–25	C. I. fittings	30–40
Steel plates	10	Malleable fittings	50–75
Galvanized sheets	14	Alcohol	40–50
Fire hose	25	Paper towels	5
El. tools	15	Rubber gloves	5–10
Fuse wire	10	Conduit	30–40
Machine bolts	5–20	Meter seals	11
Carriage bolts	5–20	Envelopes	30–40
Brooms	5–10	Paper	5–25
Brushes	5–10	Paper clips	10
Drills	10–15	Rubber bands	10
Lumber	20–40	Filing equipment	20–30
Mops	10–15	Steel shelving	15–20
Fuel oil	4– 6	Steel furniture	20, 30
Lubricating oil	4–12	Hoisting cable steel	10
Soap	5–10	Galvanized steel pipe	30–40
Solder	30	Files	15
Coal	30–50		

labor are the biggest single handicaps to economy—not prices of electrical equipment. Coal has greatly increased in price at the mine yet it must be used. Except for replacement and maintenance expenditures, utilities do not now need to buy cables, power station equipment, etc., in quantities and will not buy until increased business forces expansion. Thus the prices of supplies and of fuel are of greatest interest and the increases noted undoubtedly will have an appreciable effect on increasing operating expenses. But until further facts are had, no one can say that the prices now quoted are unreasonable. Nor can one say that in general they are higher than are justified by the increase in costs brought about by NRA. The general conclusion is true that, in general, the increased prices have not yet brought prosperity to those who sell nor prevented buying by purchasers when necessity brings them into the market.

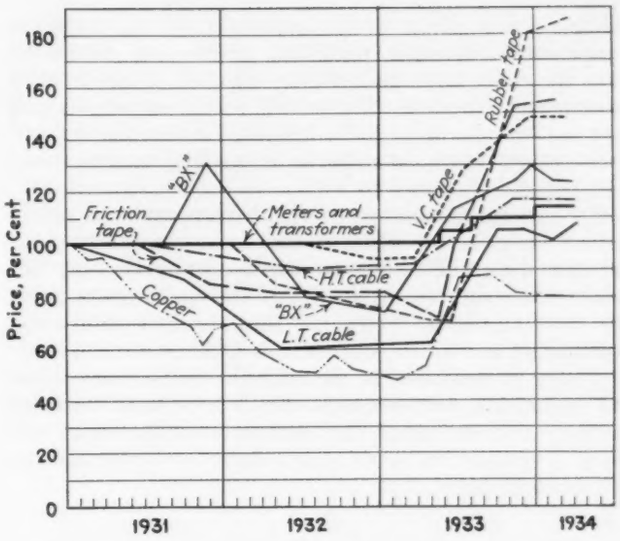
But is there a free market? Price stability has prevailed in the sale of many items of electrical manufacture in the past. Discounts, margins between large and small manufacturers and other trade practices had been worked out as a matter of business experience. Of course, there was always a recalcitrant minority and, of course, there were recurrent breakdowns, but, in general, a quite stable price situation prevailed.

Have the codes changed this situation? Yes, in some respects. Two movements, however, must be studied and measured. One was the readjustment of manufacturers to a changed volume of business and the other was the attempt to put codes into operation. Prices, margins and discounts of the 1928-1931 vintage were not satisfactory for the business volume and conditions of the latter part of 1933 and the early part of 1934. No purchaser, for example, was buying, say, $500,000 worth of distribution transformers, of motors or of wire in a year and discounts set up on this type of large annual purchase were meaningless. A readjustment to fix discounts in terms of volume of purchase was necessary and advisable and much of this has been done and would have been done with or without a code.

But the code did introduce some favorable factors. It made it possible to force all manufacturers of one product into a group forum for mutual aid and operation. It made it possible, if they so desired, for manufacturers to agree upon and use published prices and discounts. These two effective aids have been brought into play.

Table II—Increase in Prices of Electrical Apparatus and Supplies Since 1931

	Per Cent		Per Cent
Friction tape	50–80	Air breakers	10
Rubber tape	30–50	Underground cable	30–40
Splicing compound	15–20	Parkway cable	50–60
Cutouts	10–30	Watt-hour meters	5–10
Line hardware	15–30	Distribution transformers	8–10
Plug fuses	10–40	Fractional motors	20–25
Connectors	15–25	Integral motors	10
Control equipment	10–15	Generators	5
Fuse blocks	10–15	Condensers	5
Fuse wire	30–40	Batteries	5
Steel guy wire	30–40	Frequency changers	5
Copper lugs	30–40	Voltage regulators	3–5
Transformer oil	5–10	Arresters	10–20
Wiring devices	10–30	Control cable	30–60
Appliances	10–20	Instrument transformers	10
Poles	10–30	Insulators	6–25
Crossarms	10–15	Outdoor switching equipment	5–10
Meter boxes	30–40	Switchboard wire	15–20
Street-lighting globes	8–15	SBRC wire	25–40
Knife switches	10	Weatherproof wire	15–30
Oil breakers	10		



Typical price changes for one purchaser since 1931

The mutual discussion and individual education involved in getting all together in a group has aided the development of better business practices. But, as yet, this trend is wholly voluntary and without enforceable effects upon prices or trade practices. Perhaps this is well, for price fixing is a dangerous doctrine. Nor has the published price and discount plan worked very well. In general, it has meant either a succession of price filings in an endeavor to beat the competitor's prices, and thus lower average prices, or it has brought into play persuasion and sometimes even coercion to force stability in prices and discounts. In some instances, at least, the practical effect has been to get this price stability, although this was not done as an outright procedure—the patent pooling and cross-licensing schemes here enter into play. Some evidence of these effects appear in the sudden and uniform price increases for a given item that have been announced from time to time. But not all of these announcements have been applied successfully. Some have been announced, but they have broken down at the end of a short period, with a resultant lower and more unstable price situation than before the announcement. In other instances, however, a stable price and discount situation prevails and is used by all manufacturers of a particular product. At present there is no enforcement possible on prices and the human traits of fear and avarice now as always outweigh gentlemen's agreements. The effect of the code is as yet negligible for bringing about either uniform or unreasonable prices or discounts as workable business practices.

On the general question of common prices and discounts the two or three larger manufacturers are now and have nearly always quoted about the same prices for standard products and the smaller manufacturers have quoted about the same prices with the exception of differentials up to some 30 or 40 per cent on some products. These differentials were abnormally large in many instances and have been decreased. No one, however, knows just what they should be, if any, and one might say that the present is a cut-and-dry attempt to reach reasonable values. The code has aided in this attempt to find a reasonable limitation to this type of differential. It also has stopped much of the cut-throat

bidding for a given order, especially if this involves equipment sold under published prices and discounts. Thus the codes have undoubtedly affected prices directly by increasing the cost of labor and materials, but, as yet, have not had any appreciable influence in permitting legal price agreements to be made or in making unreasonably high prices.

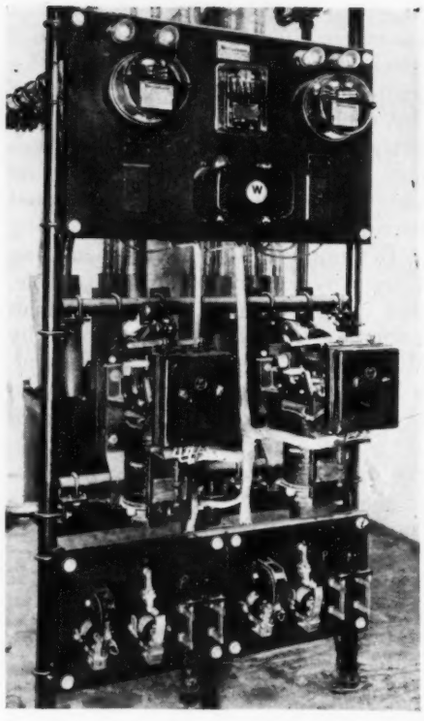
The general conclusion of this investigation of prices and of the effect of codes is that prices have increased and that the trend is for an increase in agreements between manufacturers as to prices and as to trade practices. If carried to extremes, there is opportunity for exploitation and abuse, but there is little evidence of this at present as compared to the evidence that a more stable and reasonable price situation exists because of business recovery and the moral and persuasive influence of the codes. The situation needs to be watched and controlled as well as encouraged.

Automatic Feeder Selection Protects Six-Theater Supply

By JAMES J. GODWIN
St. Louis Service Department,
Westinghouse Electric & Manufacturing Company

Power installations like that in the new St. Louis auditorium have a large connected load that must be maintained if possible in its entirety, or at least to the extent of emergency and exit lighting, so reserve power supply must be furnished. In addition, in this case, automatic supervision of the supply is maintained by means of relays to keep the main load tied to a feeder capable of carrying the load. The auditorium was opened several months ago.

This installation involves supply to six theaters, one with a seating capacity of 12,000, one with 3,600 and four with 700 each, and in addition space for exhibitors, committee rooms, dressing rooms and cafeteria. Lighting, elevators, ventilating and air cleaning and conditioning equipment, projection machines and lighting require a total power of more than 3,000 kw. Main supply sources are two 4,000-volt, three-phase feeders, each coming from separate substations of the power company and either more than sufficient to care for the entire building load, one being "standby" for emergency. A direct-current feeder from the power company or an engine generator in the building provide emergency exit lights if main power fails in its entirety.



Automatic equipment mounted on this compact transfer panel selects the "preferred" feeder for supplying power to the St. Louis auditorium

Continuous supervision of the two main feeders is employed such that the load is not only on a capable feeder, but the "preferred" feeder if both are capable; in case of failure of one, the equipment switches load to the other. This supervision is done by a type CP relay which detects voltage or phase failure, and the switching is performed by type F-22 electrically operated oil circuit breakers. A requirement of the equipment is that it must not switch from the emergency feeder back to the preferred one immediately on first indication that the preferred is in good condition, but must wait a sufficient period of time for the power company's substation breakers to attempt and fail to reclose the preferred feeder at least three times, to be certain that the restoration of the feeder is permanent or that it will be definitely held out of service. This delay is secured by means of a type KU-2 timing relay.

Type CP relays watch the two supply sources for a voltage or phase failure

A Merchant Views T.V.A.

I regard the Tennessee Valley Authority as a huge governmental mistake. I heard Dr. Morgan, its head, make a lengthy address on the subject and came away thoroughly convinced that he, himself, did not know what it was all about. Spending millions of taxpayers' money to put the government in competition with our public utilities and distributive trades is a serious menace to the continued prosperity of this country. T.V.A. and similar governmental ventures into business are nothing more than stupid and costly experiments.

David Owens,
President National Retail Dry Goods Association.

Simple Ground Relaying Trips Rural Feeders

Using stored energy to trip breakers is a refinement in line protection practice which calls for unusual resourcefulness. It has been done.

By J. F. PENNINGTON and J. T. LOGAN
Georgia Power Company, Atlanta

Return on investment from rural lines is usually small, requiring that this class of service be rendered at a minimum cost. This forced economy has in some instances reflected upon the reliability of protective measures to the extent that many rural lines are inadequately protected, particularly for single-conductor-to-ground faults. The nature of this class of service, in general, requires that lines parallel highways, cross wire fences and rural telephone lines, traverse stock farms, etc., all of which emphasize the importance of de-energizing the line as quickly as possible after it comes in contact with the earth.

Tripping the circuit breakers by means of low-voltage, trickle-charged batteries has been used quite extensively in the past, but has never proved entirely reliable. The seriousness of the situation has led Georgia Power Company engineers to do considerable research with the thought in mind of developing reliable tripping methods and the outcome is that satisfactory protection for rural lines can be secured which is just as reliable as that employed on the transmission system and which is highly sensitive to ground faults. This has been accomplished without the aid of a tripping battery, thus giving a very inexpensive layout, requiring the minimum of maintenance or attention.

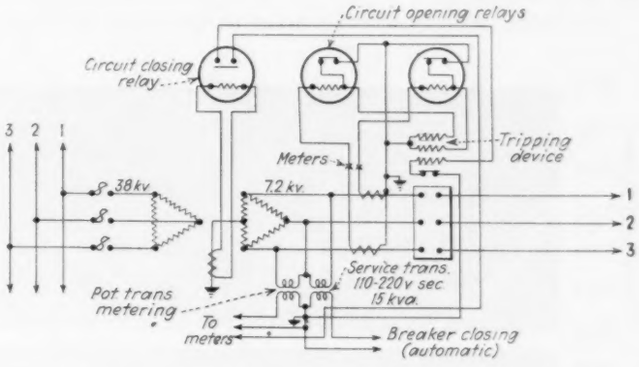
Sensitive ground protection is accomplished for either wye-connected, grounded neutral or delta-connected supply transformers. Methods of tripping are identical, however, the method of protecting delta circuits against grounded conductors is new on our system and is probably of general interest.

Overlap functioning of potential and current

The method of A.C. tripping might be termed overlapping current and potential. By this is meant ground faults are cleared by potential tripping up to and even beyond the point where the ground fault becomes heavy enough to produce sufficient current for tripping. The station service transformer used for closing the breaker supplies the ground relay tripping potential and is connected in such a manner that ground faults have a minimum effect on the voltage, i.e., across a phase opposite the one grounded. The potential trip coil is wound to operate over a range of from 30 per cent to normal voltage, which insures tripping for maximum ground fault conditions on No. 2 phase without the use of a current transformer and relay on this phase.

Current tripping is obtained by use of reliable induction type circuit-opening relays, or circuit-closing induction type relays in conjunction with transfer relays. Older methods of a.c. tripping have proved unreliable chiefly because of the large amount of tripping energy required, which usually exceeded the capacity of standard current transformers. Also, until recently, reliable circuit-opening relays were not available. These disadvantages have been overcome through co-operative efforts of manufacturers in developing a device for tripping breakers from stored energy and in developing reliable circuit-opening relays.

Tripping from stored energy has been found to be very positive and fast. This attachment, known as a spring-actuated tripping device, is designed to replace the conventional trip coil assembly. The operation is as follows: A spring which operates the trip plunger is compressed and latched in this position, mechanically, during the first part of the breaker-closing stroke, the operation being completed well in advance of the breaker contacts making. The device provides space for three miniature current coils and one potential trip coil which have a low volt-ampere burden and serve only to release



Feeder breakers tripped by "overlapping" voltage and ground-current relays

A tap is brought out, preferably from the midpoint of the secondary winding, of one transformer and solidly grounded through a low-ratio current transformer. On a few installations of 7,200-volt transformers the tap is brought out from one of the 2,400-volt terminal board taps, in which case the phase voltages to ground are 2,400, 4,800 and 6,350 volts. A midpoint tap gives potentials to ground in the ratio of 0.5, 0.5 and 0.86. The neutral current transformer ratio is such that the line may be tripped with a flow of as low as 1 primary ampere to ground.

the spring trip. The energy stored in the spring is sufficient to trip any modern breaker, yet the current transformers need supply only the energy required to release the springs. The device has been applied to breakers up to 46 kv. rating and provides positive tripping from 20/1 ratio bushing type current transformers. Station type current transformers are used where a lower ratio is desired, and on all voltages of 11 kv. and below.

The method of grounding may possibly have limitations as to the upper voltage limit of lines on which it can be used due to slight unbalanced charging currents to ground which might cause telephone interference if close coupling exists. It is not believed, however, that any noticeable effect will be experienced on voltages under 13.2 kv. On the Georgia Power Company's system there are numerous installations on 6.9-kv. and 11-kv. lines, none of which have resulted in interference.

This method of tripping has proved so reliable that its use is no longer restricted to rural lines. It has been applied to several large distribution substations, some of which require directional protection for the high-voltage supply lines. The performance on some fifty installations has been on a par with schemes employing 125-volt storage batteries and superior to jobs employing tripping batteries of 48 volts and below.

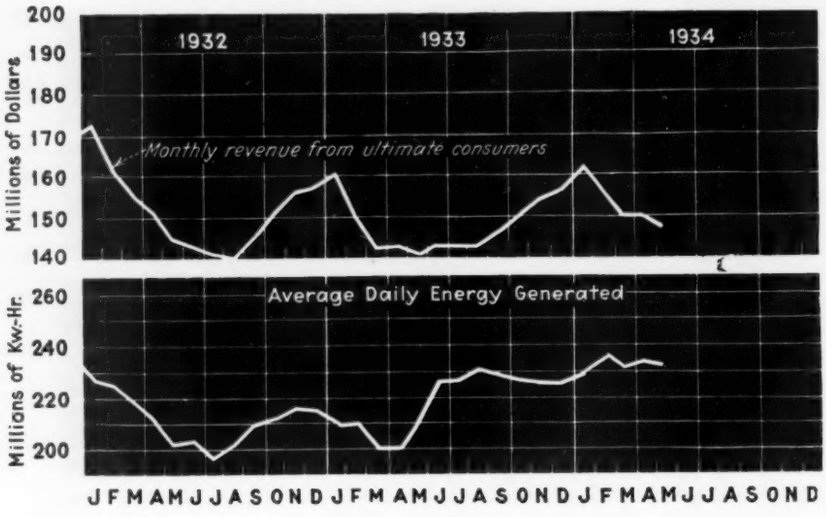
Utility Gains Over 1933 Continue

Revenue for May, $147,915,400, rose 4.8 per cent compared with 1933, the Pacific States leading with 7.5 per cent. Rising loads and low water forced steam output up 26 per cent.

IN RESPECT both to revenue and to energy output electric light and power companies are doing somewhat better than they did a year ago. Revenue from ultimate consumers in May was $147,915,400, or 4.8 per cent higher than in the like month of 1933, according to the Edison Electric Institute, and energy output was up 9.8 per cent. Thus for the third consecutive month the income ran ahead of last year's by about 5 per cent. The excess in terms of output is, of course, gradually shrinking because in the spring of 1933 factories were increasing their use of energy at an abnormal rate.

Compared with April the revenue decreased 1.3 per cent. The fact that this is smaller than the seasonal decline in corresponding periods of earlier years, when the industry was steadily advancing in magnitude, may be regarded as a favorable feature.

Of the 7,184,793,000 kw.-hr. output 41.5 per cent was produced from water power. The amount was 9 per cent less than in April; the change reflects drought conditions in various parts of the country, causing diminished stream flow. Production from fuels increased correspondingly and was 25.8 per cent greater than a year ago. For the fifth consecutive month the figures for this portion of the output have been far in excess of those for 1933. Average daily production from both sources was about the same in May as in April.



Industrial use still increasing

While sales of energy for domestic use have been going through the usual decreasing phase of the annual cycle the margin of gain over 1933 has risen to 6.5 per cent. Small commercial light and power sales are up 6.8 per cent. The most noteworthy increase came in wholesale commercial energy sales, which advanced more than 5 per cent compared with April and 18.8 per cent compared with May of last year.

Pacific region forging ahead

The largest regional gain in revenue over 1933 occurred in the Pacific States, 7.5 per cent. The smallest was in the Southeast, 2.2 per cent. In most parts of the country the revenue increased by a much smaller percentage than the energy output; commercial gains were mainly in the low-priced group and domestic rates are falling.

Table I—Monthly Revenue from Ultimate Consumers and Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1934	Revenue from Ultimate Consumers		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
May	147,915	+4.8	7,185	+ 9.8	2,983	— 6.8	4,202	+25.8
April	149,852	+5.2	6,981	+15.2	3,282	+11.4	3,699	+18.8
March	149,780	+5.1	7,262	+15.9	2,932	+ 1.8	4,330	+27.9
February	154,832	+3.4	6,572	+11.0	2,136	—15.8	4,436	+31.0

Table II—Regional Revenue, Energy Output, in May, 1934

Compared with Corresponding Month of Previous Year

Geographical Region	Revenue from Ult. Consumers		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
United States	147,915	+4.8	7,185	+ 9.8	2,983	— 6.8	4,202	+25.8
New England	12,543	+5.5	497	+12.7	300	+10.4	197	+16.4
Middle Atlantic	43,449	+3.7	1,785	+12.8	593	— 5.3	1,192	+24.7
East No. Central	33,158	+5.1	1,717	+14.3	165	—36.8	1,552	+25.0
West No. Central	12,546	+6.9	451	+ 3.5	106	—41.6	345	+35.5
South Atlantic	18,267	+2.2	871	— 3.0	503	—23.4	368	+11.2
East So. Central			271	— 4.3	220	— 8.3	51	+18.5
West So. Central	8,210	+6.4	354	+ 6.3	14	—44.0	340	+10.2
Mountain	4,150	+3.6	240	+22.5	200	+26.4	40	+ 6.5
Pacific	15,592	+7.5	999	+14.6	882	+13.0	117	+28.7

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as centra station.

Table III—Allocation of Energy, May, 1934

Compared with Corresponding Month of Previous Year

Class of Service	Millions of Kw.-Hr.	Per Cent Inc.
Total for distribution*	7,250	+11.0
Lost in transmission, etc	1,333	+ 2.9
Sold to ultimate consumers	5,917	+13.0
Domestic	967	+ 6.5
Com'l, small light and power	1,035	+ 6.8
Com'l, large light and power	3,293	+18.8
Municipal street lighting	168	+ 0.5
Railways—street and interurban	349	+11.0
Railroads—electrified steam	57	+ 4.8
Municipal and miscellaneous	48	— 9.5

*Generated, purchased from other sources and imported, less energy used in railway and other departments.

What Electricity Costs in Municipal Diesel Plants

Detailed Figures on the 1933 Operations of City Diesel Stations in Wisconsin Developed From the Official Commission Reports

By JAY SAMUEL HARTT
Consulting Engineer
Madison, Wis.

COST per kilowatt-hour of Diesel engine generated electricity at the plant buses of municipal utilities in Wisconsin ranges from 1.589 to 3.435 cents, with the highest cost *not* in the plant of least output. Details of costs and information relevant to them appear in the accompanying table and explanatory notes. The table is reproduced from a study made by the writer to determine the relative costs of purchased power and of Diesel engine generation for municipal utilities in Wisconsin during 1933. A previous article* presented the results of that study in a graph showing the cost of power consistently lower by wholesale purchase than by Diesel generation. The previous article shows also that practically all of the municipal Diesel plants in Wisconsin are of insufficient peak capacity to assure service continuity in the failure of a major unit. In that article it was promised that the costs of Diesel engine generation which were used in the graph of comparison with wholesale power purchase would be published later. This article redeems that promise.

The operating costs, investments and other data used for the cost analysis here presented were obtained from reports filed with the Public Service Commission of Wisconsin and are thus as authoritative as can be obtained. Such estimations and assumptions as were necessary to fill out the data—and which are of small total effect in the final picture—were made mostly from and with indicative evidences available in the commission records.

There are three considerations to be kept in mind in the use of figures from the cost table. One of these is the insufficiency of peak capacity already referred to, which in most of the plants cited has the effect of making power costs lower than they would be if service continuity were taken into proper account. Another consideration is that the average age of Diesel engines in Wisconsin municipal plants is low and maintenance costs for the single year of 1933 probably do not reflect the true magnitude of this item. The third matter is the present and immediately past prices for fuel and lubricating oils. These prices are and have been lower than can be expected in the future if the efforts of the national administration to restore 1926 price levels are successful.

Comparison of the fuel and lubricating oil efficiencies of the Wisconsin plants under discussion here with those stated in the 1932 A.S.M.E. oil engine report (see accompanying graphs) indicates that the Wisconsin plants are not out of line in this regard.

The cost per gallon of fuel oil during 1933 was exceptionally low as compared to such costs over the past ten years. The anticipated price increase can best be judged from the following comparisons taken from reports of those plants which were in operation in both 1926 and 1933, and from quotations in the *Oil and Gas Journal* plus freight to Wisconsin:

Plant Designation	Average Cost of Fuel Oil per Gallon—1933, Cents	1926, Cents	% of Increase
A	4.27	6.55	53
C	4.60	9.00	96
D	5.88*	6.35	8
E	5.26	7.50	43
G	5.29	8.00	51
Quoted price of 24-26 gravity fuel oil f.o.b. plant A	4.08	5.87	44

*Approximate.

There are no reported records of lubricating oil costs

(*Continued on page* 115)

Operations of municipal utilities in Wisconsin are checked more carefully by the regulatory commission than in any other state. Therefore a convincing statement of municipal Diesel plant costs can be obtained from the records of this commission. Here are some interesting cost data developed by Mr. Hartt from these official sources. An article on the service record of these plants appeared in the June 30 issue.

*"Service Records of Diesel Plants," ELECTRICAL WORLD, June 30, 1934.

Cooling Water Supply*

1. **Plant "A"**—Cooling water is obtained from the clear well of the water utility and discharged after one pass.
2. **Plant "B"**—Make-up water is obtained from the water utility for the separate engine circulating system containing heat exchangers. The heat exchangers are cooled from lake water pumped to the plant and discharged after one pass.
3. **Plant "C"**—Cooling water is obtained from the river part of the year and from the municipal water utility part of the year. It is discharged after one pass.
4. **Plant "D"**—Cooling water is obtained from the river and discharged after one pass.
5. **Plant "E"**—Cooling water is obtained from the pond above the dam and discharged after one pass. There is also an automatic connection to the mains of the water utility for emergency service.
6. **Plant "F"**—Make-up water is obtained from the water utility for the separate engine circulating system containing heat exchangers. The heat exchangers are cooled by raw water taken from the suction main of the water utility and discharged after one pass.
7. **Plant "G"**—Cooling water is obtained from the water utility and discharged after one pass.
8. **Plant "H"**—Make-up water is obtained from the water utility. The engines are cooled by a separate circulating system containing heat exchangers. The heat exchangers are cooled by means of water circulated from an outside cooling tower.
9. **Plant "I"**—Cooling water is obtained from the water utility and discharged after one pass.
10. **Plant "J"**—Make-up water is obtained from the water utility. The engines are cooled by a separate circulating system containing heat exchangers. The heat exchangers are cooled by means of water circulated from an outside cooling tower.
11. **Plant "K"**—Make-up water is obtained from the water utility. The engines are cooled by a separate circulating system containing heat exchangers. The heat exchangers are cooled by means of water circulated from an outside cooling tower.

**Refers to table below.*

Oil Engine Operation in Wisconsin—Year 1933—Compiled from Reports Filed with the Public

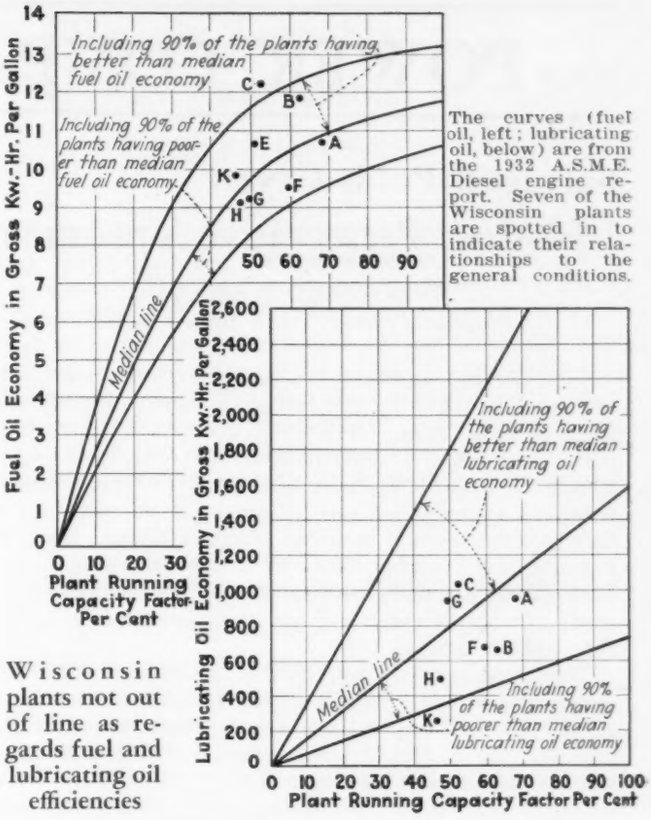
Operating Costs, from Reports	Plant "A"	Plant "B"	Plant "C"	Plant "D"	Plant "E"	Plant "F"	Plant "G"	Plant "H"
Superintendence and labor	$7,308.51	$3,578.35	$3,918.62	$5,720.00	$2,280.00	$2,873.85	$1,804.25	$3,100.73
Fuel oil	20,978.22	7,617.04	6,117.29	6,929.47	4,764.07	5,073.52	4,784.79	2,164.43
Lubricating oil	3,398.01(a)	1,310.87(a)	1,006.20(a)	496.32(b)	802.20(c)	824.31(a)	543.57(a)	623.28(a)
Cooling water	1,333.45	.....(e)	.....(f)	.....(e)	.....(e)	478.24	625.55	.....(e)
Miscellaneous supplies	805.66	1,842.04	2,182.45	1,063.35	455.93	481.92	559.30	722.83
Maintenance	2,200.07	.....(f)	314.84	2,397.40	.....(f)	.....(f)	.....(f)	.....(f)
Total	$36,023.92	$14,348.30	$13,539.40	$16,606.54	$8,302.20	$9,731.84	$8,317.46	$6,611.27
Operating Costs, Computed								
Fire and tornado insurance (g)	$630.42	$318.73	$353.86	$151.18	$205.47	$175.51	$425.41	$175.23
Compensation and liability insurance (h)	758.62	347.17	406.75	593.74	236.66	289.13	209.43	335.77
Total	$1,389.04	$665.90	$760.61	$744.92	$442.13	$464.64	$634.84	$511.00
Fixed Costs, Computed								
Taxes, 2 Per Cent	$6,267.36	$1,977.29	$2,350.22	$2,574.85	$1,698.15	$1,491.72	$2,367.05	$1,073.51
Depreciation, 5 Per Cent	15,668.39	4,943.22	5,875.55	6,437.14	4,245.37	3,729.29	5,917.63	2,683.77
Interest, 6 Per Cent	18,802.07	5,931.86	7,050.66	7,724.56	5,094.44	4,475.15	7,101.15	3,220.53
Total	$40,737.82	$12,852.37	$15,276.43	$16,736.55	$11,037.96	$9,696.16	$15,385.83	$6,977.81
Total operating and fixed costs	$78,150.78	$27,866.57	$29,576.44	$34,088.01	$19,782.29	$19,892.64	$24,338.13	$14,100.08
Investment in Plant, from Reports								
Buildings	$27,580.03	$26,851.85	$12,606.71	$20,274.11	$21,710.73	$13,312.65	$11,661.39	$12,369.46
Equipment	285,787.73	72,012.56	104,904.22	108,468.61	63,196.63	61,273.19	106,691.16(i)	41,306.00
Total	$313,367.76	$98,864.41	$117,510.93	$128,742.72	$84,907.36	$74,585.84	$118,352.55	$53,675.46
Statistics								
Kw.-hr. generated	5,238,400	1,730,300	1,607,200	1,055,600	1,002,400	913,700	834,050	497,685
Kw.-hr. station use	319,040	89,188	96,432(j)	63,336(j)	60,144(j)	72,742	76,705	29,861(j)
Kw.-hr. plant send-out	4,919,360	1,641,112	1,510,768	992,264	942,256	840,958	757,345	467,824
Station use in Per Cent of generation	6.09	5.15	.....(k)	.....(k)	.....(k)	7.96	9.20	.....(l)
Gallons of fuel oil used	490,942	146,565	131,520	117,825	94,541	96,170	90,530	54,396
Gallons of lubricating oil used	5,530	2,627	1,548	.....(k)	.....(k)	1,358	896	1,010
Kw.-hr. generated per gallon of fuel oil	10.67	11.81	12.22	8.96	10.60	9.50	9.21	9.15
Kw.-hr. generated per gallon of lubr. oil	947	659	1,038	.....(k)	.....(k)	673	931	493
Cost of fuel oil per gallon, cents	4.27	5.19	4.60	.....(k)	5.26	5.27	5.29	4.67
Cost of lubricating oil per gallon, cents	61.5	49.9	65.0	47.0(l)	.....(k)	60.7	60.7	61.7
Investment in plant per horsepower	$87.05	$94.16	$71.22	$107.29	$106.13	$124.31	$109.59	$149.10
Kw.-hr. generated per horsepower	1,455	1,648	974	880	1,253	1,523	772	1,382
Running plant capacity factor (n)	67.87	62.80	52.54	.....(k)	50.91	59.49	49.16	47.53
Costs per Kw.-Hr. of Plant Send-Out								
Superintendence and labor, cents	0.149	0.218	0.259	0.576	0.242	0.342	0.238	0.663
Fuel oil	0.427	0.464	0.405	0.698	0.506	0.603	0.632	0.463
Lubricating oil	0.069	0.080	0.067	0.050	0.085	0.098	0.072	0.133
Cooling water, misc. supplies and maintenance	0.088	0.112	0.166	0.349	0.048	0.114	0.156	0.154
Insurance	0.028	0.041	0.050	0.075	0.047	0.055	0.084	0.109
Fixed costs	0.828	0.783	1.011	1.687	1.171	1.153	2.032	1.492
Total	1.589	1.698	1.958	3.435	2.099	2.365	3.214	3.014

over any extended period of time. Such records as are obtainable from the files of the Public Service Commission indicate that the present price is substantially in accord with the costs in previous years.

Combining the figures on all eleven of the plants in the table, the weighted average proportions in the cost per kilowatt-hour of send-out from Diesel engine plants in Wisconsin in 1933 are:

	Per Cent
Labor	13
Fuel oil	23
Lubricating oil	4
Cooling water, miscellaneous supplies and maintenance	6
Insurance	2
Fixed costs	52
Total	100

These proportions cannot be taken as of general application to Diesel engine plants. They only state operations in one year for a comparatively small number of plants. If a longer period and a larger group of plants were covered these proportions might be materially changed.


Including 90% of the plants having better than median fuel oil economy
Including 90% of the plants having poorer than median fuel oil economy
Median line
Fuel Oil Economy in Gross Kw.-Hr. Per Gallon
Plant Running Capacity Factor Per Cent
Including 90% of the plants having better than median lubricating oil economy
Including 90% of the plants having poorer than median lubricating oil economy
Lubricating Oil Economy in Gross Kw.-Hr. Per Gallon
Plant Running Capacity Factor Per Cent

Wisconsin plants not out of line as regards fuel and lubricating oil efficiencies

The curves (fuel oil, left; lubricating oil, below) are from the 1932 A.S.M.E. Diesel engine report. Seven of the Wisconsin plants are spotted in to indicate their relationships to the general conditions.

Service Commission of Wisconsin

Plant "I"	Plant "J"	Plant "K" (6 mos.)
$2,588.00	$3,000.00	$716.25
2,872.87	2,035.02	655.71
904.20(d)	499.50(a)	332.08(a)
.....(e)	.....(e)	.....(e)
309.16	341.49	177.20
.....(f)	.....(f)	.....(f)
$6,674.23	$5,876.01	$1,881.24
$87.37	$112.60	$60.94
294.98	331.20	104.94
$382.35	$443.80	$165.88
$1,146.36	$904.17	$365.46
2,865.91	2,260.42	913.64
3,439.09	2,712.51	1,096.37
$7,451.36	$5,877.10	$2,375.47
$14,507.94	$12,196.91	$4,422.59
$4,707.98	$3,304.90	$2,144.71
52,610.26	41,903.52	34,400.98
$57,318.24	$45,208.42	$36,545.69
452,100	438,000	149,600
27,126(j)	26,280(j)	15,740
424,974	411,720	133,860
.....(k)	.....(k)	10.52
59,471	43,180	15,218
.....(k)	999	593
7.60	10.14	9.83
.....(k)	438	252
5.98	5.00	4.50
.....(k)	50.0	56.0
$95.53	$150.69	$174.03
754	1,460	1,425(m)
.....(k)	.....(k)	46.50
0.609	0.729	0.535
0.676	0.494	0.490
0.213	0.121	0.248
0.073	0.083	0.132
0.090	0.108	0.124
1.753	1.427	1.775
3.414	2.962	3.304

Notes

(a)—Separated from "Miscellaneous Supplies" by multiplying reported number of gallons used times the average cost per gallon.

(b)—Separated from "Miscellaneous Supplies" on basis of 1,000 kw.-hr. generated per gallon of oil.

(c)—Separated from "Miscellaneous Supplies" on basis of 750 kw.-hr. generated per gallon of oil—oil at 60 cents per gallon.

(d)—Separated from "Miscellaneous Supplies" on basis of 300 kw.-hr. generated per gallon of oil—oil at 60 cents per gallon.

(e)—Not known if included in report.

(f)—Included with "Miscellaneous Supplies."

(g)—Computed at published rates set by "Fire Insurance Rating Bureau" with 80 Per Cent co-insurance. Used 80 Per Cent condition of buildings and 75 Per Cent condition of equipment.

(h)—Compensation insurance computed at published rates set by Wisconsin Compensation Rating and Inspection Bureau. Liability insurance computed at published rates set by National Bureau of Casualty and Surety Underwriters.

(i)—Adjusted to include payments not yet made on equipment.

(j)—Estimated at 6 Per Cent of generation.

(k)—Data not available.

(l)—Approximate.

(m)—Computed on an annual basis.

(n)—Computed by A.S.M.E. formula.

Truck Refrigeration Adds an Off-Peak Electric Load

An ideal off-peak load has been added to many lines through application of stored refrigeration to ice cream and other refrigerated trucks. Refrigeration capacity in one method, according to the Kansas City Power & Light *News*, is stored up at night in a substance technically known as cryohydrate, which when solidified will absorb in melting many times as much heat as an equal volume of ice. This method of cooling employs equipment manufactured by the Kold-Hold Manufacturing Company, Lansing, Mich. The usual truck is equipped with three units and coils to carry the refrigerating liquid mounted in a well-insulated body. A small refrigerating plant is suspended at the side under the body. At night the refrigerating unit is connected to the garage circuit and the temperature of the cryohydrate reduced until it solidifies.

In ice cream service the temperature of the body is reduced to about 14 deg. below zero and by the end of the day the temperature inside will not have risen to more than one or two degrees above zero. About 5 to 10 kw.-hr. per day is required to refrigerate a 300-gal. body, which at night power rates is quite economical when compared with other refrigerating methods. One ice cream company reports an operating cost of 15 cents per day at a 1½-cent rate, as compared with $2.77 for the same summer period the previous year using dry ice.

... POWER COMPANY ENGINEERING

Salvaged Poles Given Low-Cost Preservative Treatment

By HOWARD P. SEELYE
Engineering Division, Detroit Edison Company

Considerable numbers of old, untreated cedar poles are being salvaged by the Detroit Edison Company and used on farm lines. It seemed desirable to give these poles some form of butt treatment to insure as long a useful life as possible, in conformity with the company's policy of using only treated poles. On the other hand, there were no local treating plants available, and the expense of a complete plant of the conventional, steam-heated type seemed unwarranted by the comparatively small number of poles and the irregularity of the quantities to be handled.

The problem was solved by the installation of a small, electrically heated tank. An old transformer tank large enough to hold ten or twelve poles was buried in the ground. In it were placed some electrical immersion heaters, about 20 kw. capacity in all. These were shielded from injury by slotted guards. A rack was placed in the bottom of the tank to hold the poles off the extreme bottom. Poles are handled in and out of the tank by the pole-yard derrick.

Treatment consists in heating the poles in the oil for about four hours, then letting the oil cool down for at least four hours more. Any other desired cycle can be used. The plant has quite an appreciable capacity if operated 24 hours per day, and this could be increased, if desired, by the addition of a cold-oil tank, transferring the poles to it after heating and keeping the hot tank at constant temperature. The oil used is a by-product gas-tar oil. This is probably not as effective a preservative as creosote, but was shown by test to be fairly good. It was available at a very low cost and was deemed satisfactory for salvaged poles in view of the uncertainty of their remaining life above ground. Creosote oil could be used if the service warranted it.

Two such plants have been installed at different pole yards, costing complete about $160 each. An advantage of this type of plant is that it can be built economically in any size from one-pole capacity up, making it feasible to have one at any point where it can be made useful. Also, it can be readily moved if desired and can be operated intermittently without much increased cost. The cost of treatment is estimated at not more than 30 cents per pole, including labor and electrical power. These figures should not be compared directly with costs of commercial treatment, since some salvaged materials were used in building the plant and the cost of the oil used is negligible. For the purpose, however, they are very favorable, allowing a reasonably good treatment to be applied to salvaged poles at a small expense.

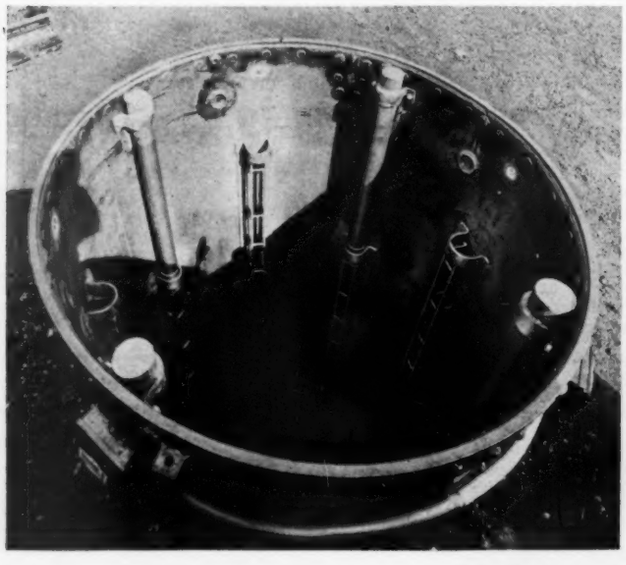
Fuses Save Industrial Customer Investment

By J. H. EVANS
Electrical Engineer Boston Edison Company

Recent developments in the design of power fuses of high interrupting capacity have enabled the Boston Edison Company to modify its requirements for high-tension industrial installations, so as to reduce the customer's necessary investment considerably.

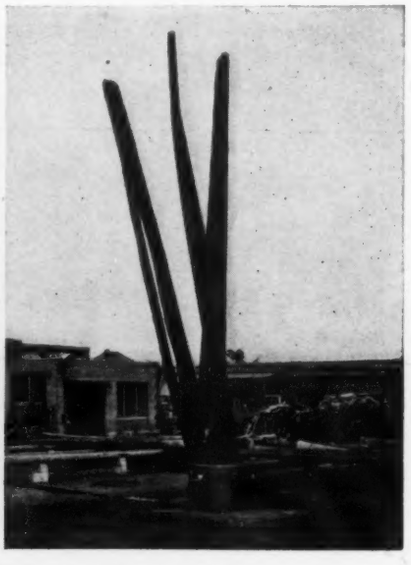
As an alternative to installing for each transformer bank a circuit breaker equivalent in interrupting capacity to those provided by the company for its transmission line loop, the customer has the option of installing certain approved types of fuses in series with a non-automatic oil switch, or with a breaker of moderate interrupting capacity connected to trip only from current transformers installed on the secondary side of the industrial transformer bank.

It is felt that this scheme, as compared with that outlined by Richard Banz in the June 16, 1934, issue of the ELECTRICAL WORLD has the advantage that it permits the transmission line loop to remain closed



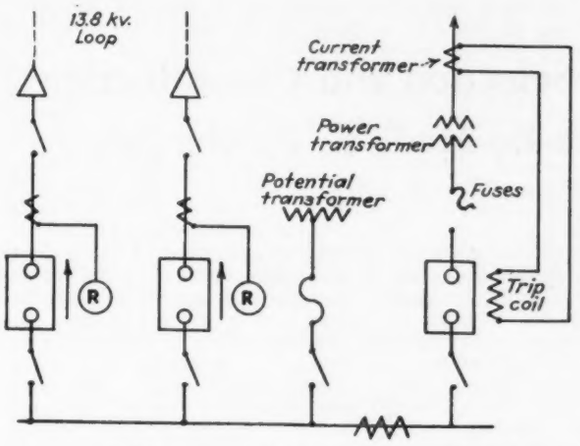
How heaters are installed (left)

Four heaters are in place in this tank. Guards are set for four more.



Treatment plant in operation (right)

PRACTICE . . .

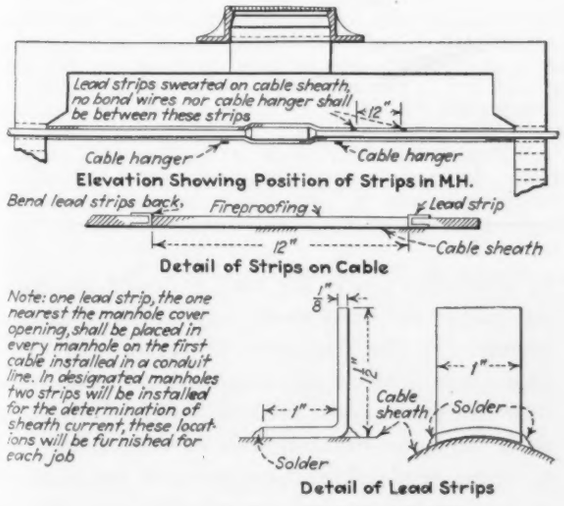


Approved fuse connections for industrial customer

in the event of a short circuit in the customer's transformer bank. As indicated in the diagram, the line breakers at the customer's substation are connected to trip from directional relays on exterior system faults only, and the characteristics of the approved fuses are such as to insure their blowing before any other breaker in the loop can normally operate.

The estimated saving which accrues to the customer by the adoption of this type of protection ranges from about $1,000 to $1,800 for each transformer bank, depending upon the value of the short-circuit duty at the location of the particular installation.

How to Install Electrolysis Contacts

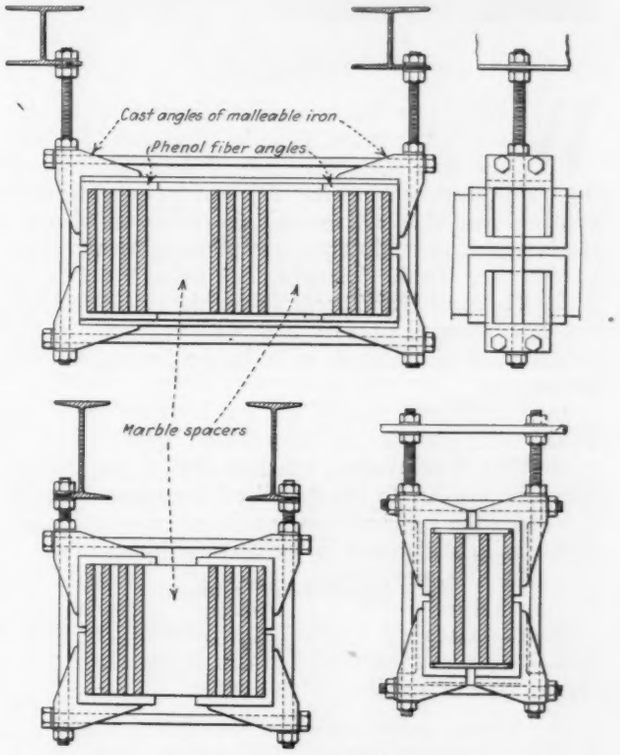

Lead strips sweated on cable sheath, no bond wires nor cable hanger shall be between these strips
12"
Cable hanger
Cable hanger
Elevation Showing Position of Strips in M.H.
Bend lead strips back
Fireproofing
Lead strip
12"
Cable sheath
Detail of Strips on Cable
Note: one lead strip, the one nearest the manhole cover opening, shall be placed in every manhole on the first cable installed in a conduit line. In designated manholes two strips will be installed for the determination of sheath current, these locations will be furnished for each job
1/8"
1 1/2"
1"
1"
Cable sheath
Solder
Solder
Detail of Lead Strips

Electrolysis is a problem in underground cable use. The accompanying illustration shows the installation of electrolysis contacts in manholes as used by the Kansas City Power & Light Company.

Bus Hanger Assembly Is Readily Expandable

BY RICHARD BANZ
Chicago, Illinois

Bus hanger assemblies of unusual simplicity and flexibility are now widely used on the system of the Commonwealth Edison Company, particularly in low-tension direct-current bus construction. The essential parts of the hanger are four cast angles of malleable iron and four phenol fiber angles. These, with the necessary bolts, marble and asbestos lumber spacers, flat steel pieces and micarta boards, constitute a hanger assembly which, as shown in the illustration, may be used for single or multi-run buses with any number of bars up to the weight



One hanger assembly carries single or multiple bus runs

capacity of the suspension members. There are no threads in or on any parts except the bolts and nuts themselves. Leveling is easily accomplished by moving the nuts on the vertical bolts.

In the upper right hand corner of the illustration is a side elevation of the hanger. This detail shows the double cross bolts at top and bottom and the fiber angles extending beyond the cast iron angles on each side. In the lower left detail the busbars and the asbestos lumber spacers between them rest directly on the fiber angles. This is possible because the marble spacer in the center also has a bearing on these angles. When the center spacer is thin, as in the lower right detail, micarta strips are necessary at top and bottom. When the assembly is extremely wide, as in the upper left detail, steel plates are used to provide support for the center elements of the assembly.

Which Motor? Which Control?

Only by Proper Selection and Co-ordination May the Drive Be Made to Fit the Job

By
GEORGE H. HALL
Consulting Engineer, New York

WHEN one has determined the type of service for which the motor is to be used and has analyzed the load requirements* the general data regarding the performance of the different types of motors and controls available will permit the selection of the particular type most closely corresponding to the demands of the case. In the following discussion the data will be limited to motors and controls for the standard commercial low voltages of 110, 220, 440 and 550. All data, unless otherwise stated, will also be limited to 60-cycle frequency.

In referring to speeds, the synchronous speed will be used, although the actual full-load speeds of motors, other than synchronous, are less than 6 per cent below synchronous due to the "slip" of the rotor. For ready reference the synchronous speeds of motors for several frequencies are shown in the accompanying table.

Squirrel-cage motors

Four classes of squirrel-cage motors are provided, each having characteristics to suit it especially to a particular type of service. These are:

(A) Normal starting current, normal starting torque.
(B) Low starting current, normal starting torque.
(C) Low starting current, high starting torque, normal slip.
(D) Medium starting current, high starting torque, high slip.

The relative starting currents and starting torques of these four types of squirrel-cage motors are as outlined below.

(A) *Normal Starting Current, Normal Starting Torque*—The starting torque of this type of motor is usually about 50 per cent greater than the full-load torque. In accordance with the recommendations of the National Electrical Manufacturers Association (N.E.M.A.) it shall not, at rated voltage, be less than 50 per cent greater than the running torque for all two- and four-pole motors. For motors having more poles than this it may taper off until, in a fourteen-pole machine, it may be but 10 per cent greater than full load, but in no case shall the starting torque be less than full load at any speed from zero (or no load) to full load.

The starting current of this type of motor, for practically all of the standard makes, runs considerably over the limitations set by the former National Electric Light Association, and also of N.E.M.A., as to the maximum which may be measured when the motor is thrown directly across the lines. The limit in size accepted by the power companies is generally placed at 5 hp., and motors of larger size employ some type of starter by which the inrush of current is held within limits. These limiting currents apply for general guidance and may be modified by (a) capacity of total installation, (b) where low-voltage network distribution is employed. The types of starters for this purpose will be considered later, but it will be readily appreciated that the use of any current-limiting starting device will materially increase the cost of the installation. For this reason a modification of the squirrel-cage motor is available in which the starting current is kept within the limits and the use of a starter is obviated. This modification is known as:

(B) *Low Starting Current, Normal Starting Torque*—In this type of motor the rotor bars are so shaped and located that a high impedance is produced at starting, which limits the inrush of starting current. The starting torque, however, is in practical correspondence with that of the normal starting current type. It is therefore capable of the same starting service and, as the inrush of current comes within the E.E.I. limits, it is generally accepted by the utility companies for throwing directly across the line in starting, in capacities up to 30 or 40 hp.

While the special construction renders the cost of the motor itself slightly higher than that of the normal starting current type, the increase is far less than that of the current-limiting starter, or compensator, that would otherwise have to be used.

(C) *Low Starting Current, High Starting Torque, Normal Slip*—A further modification of the low starting current type of motor is found in the high starting torque type. In this motor a double rotor winding is provided, an outer, high resistance, low reactance winding and an inner, low resistance, high reactance winding. In starting the current flows in the outer winding due to the high reactance of the inner winding. The high resistance of this outer winding reduces the inrush of current. As the motor comes up to speed the rotor frequency, and therefore the reactance, of the inner winding decreases, the current passes down into the low resistance inner winding. At full speed the frequency in both windings becomes practically zero, the flow of the current through the inner winding increases and it becomes an active part of the rotor circuit and carries the load. The characteristics of this type of motor fit it for use where a high starting torque is required and at the same time its low starting current permits it to be thrown across the line without the use of current-limiting devices.

(D) *Medium Starting Current, High Starting Torque, High Slip*—By the use of a high-resistance rotor which allows the motor to slow down, or "slip," under overloads this modification

In a previous article Mr. Hall reviewed the essential factors for study in the application of electric motors. In this discussion he reviews the available types, gives their characteristics and shows how controls may be used to modify them better to fit the motor to the specific service required. A practical, semi-technical approach to the selection of modern motors and controls that they may do their tasks in industry to the best advantage of users, power company and manufacturer.

*ELECTRICAL WORLD, *June 16, page 880.*

of the squirrel-cage motor is especially adaptable to the operation of machines equipped with flywheels which are depended upon to produce energy during the working stroke. When this takes place the flywheel, in carrying the load over the peak, slows down. If the motor continued to run at its full normal speed a heavy strain would be imposed on the motor windings so it is essential that the speed of the motor should slow down to correspond with the slowing of the flywheel. As will be seen by reference to characteristic curves, as the speed decreases the torque increases, thus providing ready power to restore the speed of the flywheel as soon as the peak of the load is passed.

Although the starting current of this type of motor is somewhat higher than that of the low current types it is sufficiently low to permit across-the-line starting. The slip at full load of the high slip motors is from 7 to 12 per cent and these motors should not be used for driving machines that are not flywheel-operated. High resistance rotor motors may be used for breakaway torque and acceleration as well as for flywheel starting. Suitability for frequent reversing, high accelerating capacity and rapid acceleration are secured at some sacrifice in efficiency.

Multi-speed squirrel-cage motors

As has been previously stated, the speed of a squirrel-cage motor, of a given frequency, depends upon the number of its poles and in its standard form it is strictly a single-speed machine. If, however, the number of poles is altered the speed of the motor is inversely altered. If a squirrel-cage motor has eight poles it will have a synchronous speed of 900 r.p.m., but if the winding is so constructed that half of the poles can be regrouped we will then have a four-pole motor and its synchronous speed will be 1,800 r.p.m. This is known as a single-winding, two-speed machine. The stator may further be built with two sets of windings so constructed as to provide twelve poles and six poles, and this will add speeds of 600 and 1,200 r.p.m. This gives us the standard two-winding, four-speed machine having four speeds in a speed range of 600, 900, 1,200 and 1,800 r.p.m. Other combinations can be made, the range often extending from 450 to 1,800 r.p.m. where a four-to-one range is necessary, but 600 to 1,800 r.p.m. is the most conventional speed combination. Three-speed machines are in reality four-speed motors with one of the groupings not employed.

The horsepower ratings of multi-speed motors depend upon the type of service required and these ratings follow the three classifications. Constant horsepower, constant torque and variable torque. In commercial practice the rating of the motor is expressed by giving the speeds and the horsepowers at the respective speeds thus:

Constant horsepower, 10 hp., 1,800/1,200/900/600 r.p.m.
Constant torque, 10/6.66/5/3.33 hp., 1,800/1,200/900/600 r.p.m.
Variable torque, 10/4.44/2.5/1.11 hp., 1,800/1,200/900/600 r.p.m.

Slip-ring, or wound-rotor, motors

The design of motor and control permits starting under extremely heavy loads without excessive starting current and also provides for smooth acceleration under starting conditions, thus rendering the slip-ring motor particularly adaptable for operating hoists, cranes, conveyors and similar apparatus where a heavy starting torque at slow speed is desired.

With proper resistance the starting torque equals about 150 per cent full-load torque on the first point of resistance and increases as resistance steps are successively cut out. Under such starting conditions the starting current will equal approximately 150 per cent of full-load current.

At normal rated load, with no resistance in the secondary circuit, the slip-ring motor has a speed of about 95 per cent of synchronous speed, but as the load increases the slip becomes greater. At maximum torque, approximately 250 per cent full load, the speed drops to about 80 per cent of synchronous. Beyond this point of load the speed becomes unstable and further overloading will cause the motor to stall. This maximum 250 per cent torque point is called the "pull-out" torque.

Synchronous Speed in Revolutions per Minute for Different Numbers of Poles and Frequencies

Frequency	Number of Poles							
Cycles	2	4	6	8	10	12	14	16
60	3,600	1,800	1,200	900	720	600	514	450
50	3,000	1,500	1,000	750	600	500	428	375
25	1,500	750	500	375	300	250	214	187

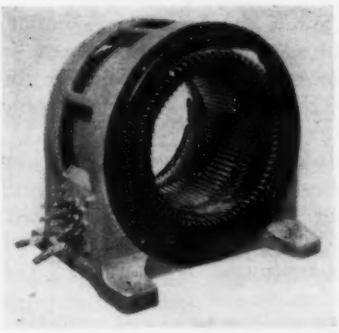
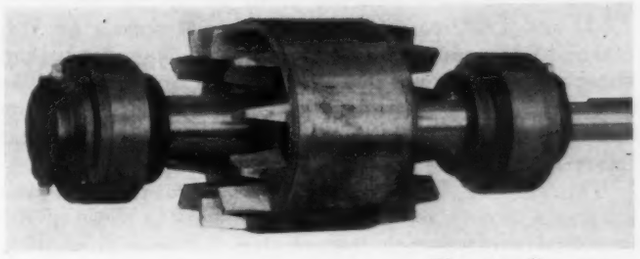


Fig. 1—Typical stator and rotor of squirrel-cage motor
General Electric Company



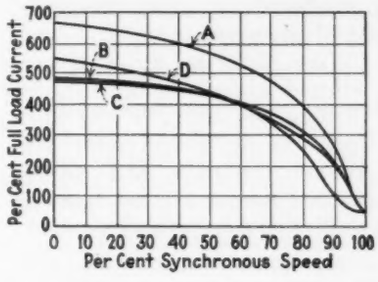
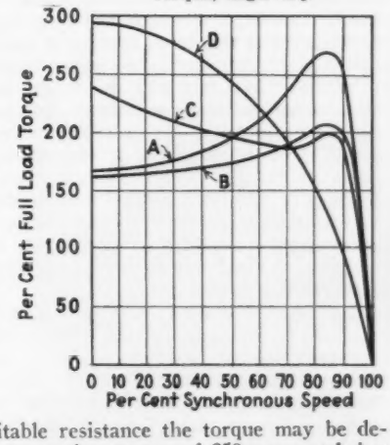


Fig. 2—Current curves of squirrel-cage motors
(A) Normal starting current, normal starting torque
(B) Low starting current, normal starting torque
(C) Low starting current, high starting torque, normal slip
(D) Medium starting current, high starting torque, high slip

Fig. 3—Torque curves of squirrel-cage motors
(A) Normal starting current, normal starting torque
(B) Low starting current, normal starting torque
(C) Low starting current, high starting torque, normal slip
(D) Medium starting current, high starting torque, high slip



By the selection of suitable resistance the torque may be developed at any desired slow speed, a torque of 250 per cent being obtainable at zero speed.

In addition to the use of slip-ring motors for the attainment of the favorable starting conditions outlined above this type of motor may be used for variable speed service. The maximum ordinary speed reduction is 50 per cent for constant-torque, adjustable-speed service. As will be seen by the curve the variation in speed drops off very rapidly with any change in load, so that a slip-ring motor operating at reduced speed will not afford as close speed regulation as the multi-speed squirrel-cage motor.

Synchronous motors

Synchronous motors, as is implied by their name, are constant-speed motors that operate at the synchronous speeds determined by the operating frequency and the number of poles for which they are wound. The stator of the synchronous motor is provided with phase windings similar to that of a squirrel-cage or slip-ring motor, but the rotor is fitted with poles which are wound for

direct-current excitation. While these are the essentials of the synchronous motor, an additional element is needed as synchronous motors will not start under the action on the synchronous components alone and some type of starting winding is required.

The motor, having "pulled in," will then run in step with the frequency, regardless of the load carried, until the maximum, or "pull-out," torque point is reached. This maximum overload capacity of a synchronous motor, in general purpose machines, is about 175 per cent of full-load torque.

General-purpose synchronous motors are classified by N.E.M.A. as those ranging from 20 hp. at speeds of 1,200 and 1,800 r.p.m. up to 200 hp. at speeds of 514, 600 and 720 r.p.m. Larger ratings and lower speeds than those coming within the above limits are classified as low-speed motors. For low-speed motors over 200 hp. the pull-in and pull-out torque points are somewhat lower than for the general-purpose machines.

The starting characteristics of general-purpose synchronous motors are practically the same as those of the standard squirrel-cage motors, but for special starting conditions the starting windings may be of the double, or of the high-resistance, single-winding type.

In the early days of the use of the synchronous motor starting and operating offered more complications than for the other types of motors, but with the present-day designs of motors and controls the synchronous motor has been developed to a point of starting and operating which is no more complicated than for other types and its use for general purposes is becoming more extended.

Power-Factor Correction—In addition to its favorable operating characteristics for certain classes of work a feature of the synchronous motor which makes it especially desirable for general use is its ability to operate at either unity or leading power factor and thus improve the power factor of the plant.

While it is a fact that the actual power consumption depends upon the actual work performed, independent of the power factor, on the other hand, the wattless current, while doing no actual work, does travel through the wires, transformers and other parts of the equipment, so that a poor power factor means a loading of the lines beyond that needed if a good power factor is maintained. Conversely, in plants where the lines and line equipment is loaded to full capacity a portion of this capacity may be released for carrying working current by an improvement of the power factor.

The synchronous motor designed for leading power factor is more expensive and somewhat less efficient than the motor built for unity power factor, so that the use of leading power-factor motors should be undertaken only after a careful study of actual operating conditions shows that their use will provide economies sufficient to warrant their installation. Standard 80 per cent leading power-factor motors are more generally employed, but it may be found upon careful investigation that in many cases satisfactory results can be obtained by the use of motors having a leading power factor of 90 per cent.

Modifications of synchronous motors

While the foregoing has referred to the standard commercial type of synchronous motor, there are available a number of modifications which are especially suited for particular applications, two of which are of interest:

The super-synchronous motor is especially designed for mill work and its particular feature is its mechanical construction, by which it starts the load with all pull-out torque available. This is attained by a special construction of the stator, whereby it is permitted to rotate freely when not restrained by a holding brake. At starting the brake is released and the starting switch is closed. As the rotor is fully loaded it remains fixed, while the stator rotates at increasing speed until it has reached approximately 95 per cent full load speed. The rotor field is then energized and the stator pulled into step. The brake is then applied, gradually restraining the speed of the stator. As the speed of the stator decreases that of the rotor increases to a corresponding degree, as the relative speed must be synchronous motor speed, so that by the time the brake has brought the stator to rest the rotor is operating properly at full synchronous speed.

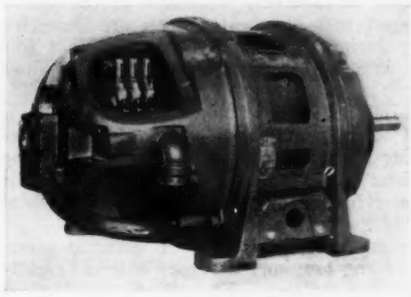
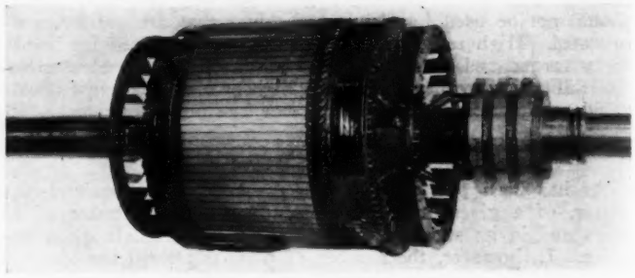


Fig. 4 — Typical wound-rotor induction motor
Westinghouse Electric & Manufacturing Company



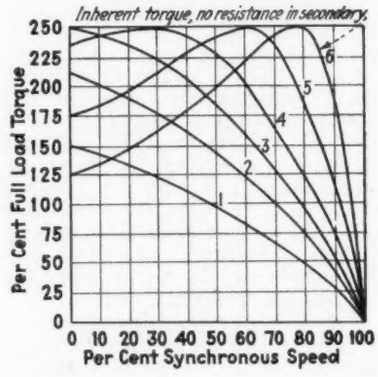
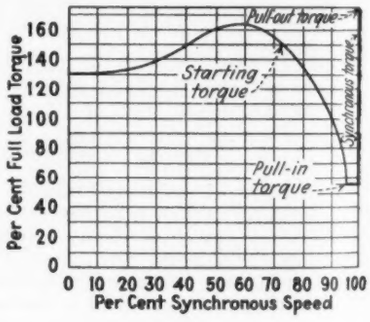


Fig. 5—Typical torque curve of wound-rotor induction motor with five points of starting resistance

Fig. 6—Torque curve of typical general-purpose synchronous motor



The Fynn-Weichsel motor is a type of synchronous motor in which the rotor is of the wound type, so that at starting it operates as a slip-ring machine. This gives the heavy starting characteristics of a slip-ring motor, slow starting control, and, when desired, it may be run at short periods with the rotor resistance in circuit at reduced speeds. On attaining the pull-in speed it automatically throws the field excitation into circuit and then operates the same as an ordinary synchronous motor. An outstanding feature of this type of motor is that if the pull-out torque is exceeded it automatically cuts out the field excitation and reverts to the slip-ring characteristics, under which it runs until the torque has been reduced below pull-out value, when it again automatically takes up synchronous operation.

Repulsion-start-induction motors

In this type of motor the rotor is provided with a winding the ends of which are brought out to a commutator. At approximately 60 per cent synchronous speed the rotor windings are short-circuited by the operation of a centrifugal switch and the motor then operates as a squirrel-cage induction motor. At the

Fig. 7—Stator and rotor of Fynn-Weichsel motor
Wagner Electric Corporation

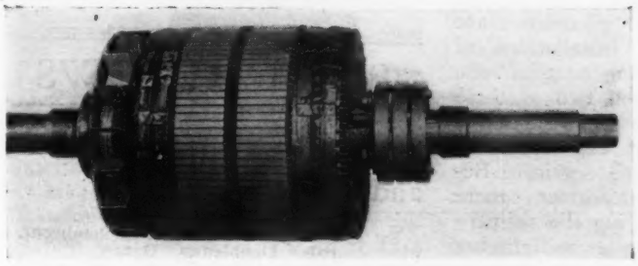
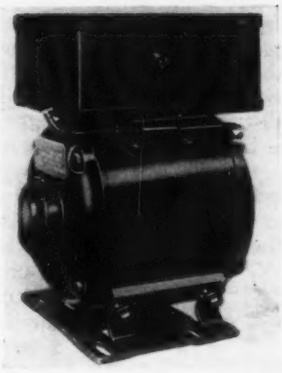


Fig. 8—Capacitor type of single-phase motor
Wagner Electric Corporation



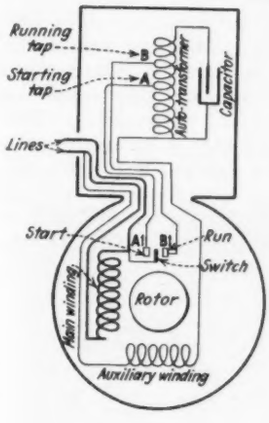


Fig. 9—Connection diagram of typical capacitor motor

point at which this changeover occurs the brushes cease to carry current by being raised from the commutator or by being short circuited. The characteristics of this type of motor are high starting torque and low starting current. As an induction motor it operates at practically constant speed regardless of load.

Repulsion-induction and split-phase motors

This type of motor has a double-wound rotor, the outer, or repulsion winding, being connected to a commutator, while the inner winding is of the squirrel-cage type. In starting the repulsion winding is operative and provides the high starting torque. As the speed increases the distribution of the current is automatically divided between the two windings. This arrangement, obviating as it does any sudden shifting over from repulsion to induction characteristics, provides very smooth starting and, as the brushes are not lifted from the commutator, any mechanical complexity of centrifugal switching is avoided.

Both of these types of motors are built in sizes up to 10 hp., although the general use of single-phase motors is usually limited in capacity to 5 hp. by the utility companies. Above this size the use of polyphase motors is usually insisted upon to avoid unbalancing of the phases, but in remote districts where a single-phase service only is available the larger sizes may be used.

The split-phase motor is provided with two stator windings, one of which is used for starting only. Because of the difference in the ratio of the resistance to the reactance in the two windings the currents flowing in them are out of phase with each other, so that, in starting, the motor partakes of the characteristics of a two-phase machine to a sufficient extent to afford starting torque. This causes the motor to come up to speed, after which the starting winding is automatically cut out of circuit and the motor then operates as an induction machine.

The characteristics of split-phase motors are comparatively high starting current and low starting torque, which renders their use undesirable for loads in which a heavy starting torque is required. For many applications, such as oil burners, office devices, domestic appliances and portable machines, all of which start under but little load, these motors are satisfactory.

Split-phase motors are seldom built in larger than fractional sizes and may therefore be started with either manual or magnetic switches, by which they are thrown directly across the line.

Capacitor motors

The capacitor motor, which is made in fractional sizes and in integral sizes up to 10 hp., is a modification of the split-phase motor providing for capacitor starting and capacitor running. It therefore starts and runs as a modified two-phase motor. The stator has two windings, main and auxiliary, spaced 90 deg. (electrically) apart. The rotor is similar to that of the squirrel-cage motor. In the fractional sizes an automatic switch is employed to break the starting circuit and make the running circuit when the motor has accelerated to about three-quarters speed. In the integral sizes this is accomplished by a voltage relay.

Variable-speed, brush-shifting motors

The brush-shifting type of motor is a modification of the repulsion-induction motor designed for variable speed work by shifting of the brush position. This is a constant torque motor, the horsepower output therefore varying directly with the speed. The commercial ratings under which these motors are sold are for the horsepower developed at rated full-load speed. If this type of motor is operated against a constant torque load of 100 per cent of the full-load rating of the motor a speed range of 4:1 is obtainable, but if the torque is less than that for which the motor is rated the speed range is somewhat reduced. Thus, if operating against a torque of but 75 per cent of its rating the motor would have a speed range of approximately 2½:1. For this reason it will be seen that it is desirable to motor the machine to be operated quite closely in order to secure the advantage of the full-speed range. The no-load speed of this type of motor is about 60 per cent above synchronous speed. The starting torque and starting current vary somewhat with the brush position, but in four-pole machines each will run from 150 to 300 per cent of normal and in six-pole machines from 125 to 250 per cent of normal full load. The maximum torque will be about 300 per cent of full-load torque.

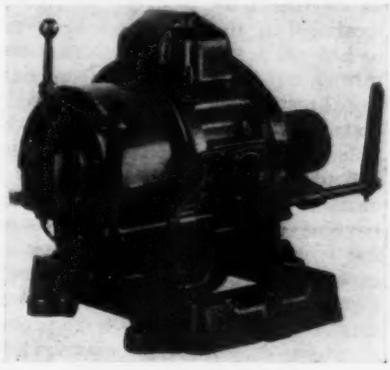


Fig. 10—Brush-shifting type of single-phase motor
General Electric Company

These motors are built generally in capacities from ¼ up to 2 hp., and are especially adaptable to the operation of small printing presses, although they can be successfully used on other types of machinery having constant torque requirements and necessitating variable speed.

As the speed adjustment depends entirely on the position of the brushes, the control of these motors is wholly mechanical. A line switch is employed for starting and stopping the motor, and this may be manually or magnetically operated. The brush shifting is achieved by the movement of a lever which may be accomplished directly at the motor or, by use of toggles and connecting rods, it may be operated remotely by hand lever or by foot pedal.

LETTERS TO THE EDITOR

Self-Protecting Transformers

To the Editor of the ELECTRICAL WORLD:

I was interested in W. G. Kelley's article in the May 12 issue of the ELECTRICAL WORLD, discussing some possible disadvantages which factory-built assemblies of electrical equipment may offer, and suggesting the close co-operation of manufacturer and user to eliminate such disadvantages. His point of view is entirely sound and I agree with it fully.

As an example of a factory-built combination which to him appears to offer more disadvantages than advantages to the user, he cites the case of the distribution transformer with built-in-protection. It may be of interest to point out that the idea of a distribution transformer with built-in protection did not originate with the manufacturers, but rather with the public utility distribution engineers themselves. We, in the Westinghouse company, were impressed by precisely the same arguments presented by Mr. Kelley and felt that we could not offer such a combination until and unless we could develop a protective device which would be at least as reliable as the transformer itself. With the development of the Deïon gap it appeared that a protective device had been found of equal or greater reliability than the transformer.

Thousands of these transformers are in service in the most severe lightning locations in the country. I have yet to hear of a single case where a transformer winding has failed from lightning because the Deïon gap did not protect it. A few Deïon gaps have failed under direct strokes of lightning due to their inability to carry the tremendous surge currents involved, but I have never seen a Deïon gap in service fail from any other cause. The surge current carrying capacity of the earliest gaps which failed from direct strokes was approximately 10,000 amp. for a duration of 20 microseconds to half value. I have on my desk today a Deïon gap so small that I can cover it with my hand, but which last week withstood in the laboratory nine surges, all greater than 100,000 amp., with a duration of 100 microseconds to half value, and several of the surges reached magnitudes as high as 130,000 amp. Two of these in a transformer should provide a path for the lightning surge current adequate to the demands of any ordinary direct stroke of lightning. Based on experience to date, I think it is safe to predict that a self-contained, self-protecting distribution transformer can be made so reliable as practically to eliminate all troubles and service interruptions from lightning.

To avoid any possible misunderstanding as to the conventional types of arresters, it should be added that the Deïon gap as designed for distribution transformer protection does not break down below surge voltages of about 40,000 to 50,000 volts and the inherent surge strength of the apparatus being protected must be sufficient to withstand such voltages. The very high inherent surge strength of distribution transformers makes the combination of Deïon gap and distribution transformer an ideal one.

This year a number of utilities are co-operating in trial installations of completely self-protecting transformers. In one such installation two of these transformers were mounted about a quarter of a mile apart, each supplying an individual customer's service. Between these two transformers there were three poles carrying the primary lines. During a severe storm lightning struck the intervening spans with sufficient violence to shatter all three poles, but both completely self-protecting transformers on the adjacent poles rode through the storm without damage and without a service interruption.

The self-protecting distribution transformer appears to be an outstanding example of progress toward greater service reliability brought about through the co-operation of manufacturer and public utility distribution engineers.

H. V. PUTMAN,
Engineering Manager.
Westinghouse Electric & Manufacturing Company, Sharon, Pa.

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Distribution Loading and the Code

To the Editor of the ELECTRICAL WORLD:

In an editorial of the June 30 issue of ELECTRICAL WORLD it is pointed out that an irreducible minimum of the distribution outlay has to do with strength and safety and with standards of construction, self-imposed and laid down by regulatory authorities.

According to Code rulings, Oklahoma City is in the so-called heavy loading district. Inasmuch as this seemed unreasonable, B. E. Lowe made a special study of the problem, as a part of his graduate study program, in the school year 1932-33.

Using a detailed Weather Bureau record for Oklahoma City, covering some forty years, he found, as a result of a probability study, that if this same weather cycle continued the heavy loading conditions would not likely occur in thousands of years.

A detailed report of this study is contained in Oklahoma Agricultural and Mechanical College Engineering Experiment Station Publication No. 20, "Rural Line Design Investigations."

In view of the great difference between the Code requirements and the probable extreme weather conditions, it seems that this offers at present one of the most promising fields for investigation for reducing this co-called "irreducible minimum of the distribution outlay." Studies similar to that carried out for Oklahoma City should be carried out for many sections of the country. Then perhaps a loading map could be prepared that would more nearly fit actual conditions than does the present map.

A. NAETER,
Professor of Electrical Engineering.
Oklahoma A. & M. College,
Stillwater, Okla.

BOOK REVIEWS

The Three Little Meters and the Telephone

By A. J. Wager and R. A. Aschenbrener. Published by Doubleday, Doran & Company, Garden City, N. Y. 40 pages. Price, 25 cents.

Washo, Wattso, Gaso and Hello talk to one another as utility people would if they knew the public was listening and wanting to understand. What they reveal about their differences and their problems starts off as kindergarten dialogue, but, unfortunately, they lapse into collegiate stiltedness before they break up. Nevertheless, there are in this booklet some gems that would click in utility good will advertising. Thus, electric utilities use up as much coal as the homes they serve. Mail delivery of a quart of milk would cost $1.14. Gaso almost convinces Washo (Washo belongs to the municipal family) that water at $10 a year is more expensive than $40 gas because no water has to be manufactured and the abutting property owner, anyhow, is assessed for the mains. Citizens above the moron level and outside the preserves of prejudice could learn from this little tract something to confound the emotion-baiting agitator.

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Tables of Functions

By Eugen Jahnke and Fritz Emde. Published by B. G. Teubner, Leipzig Cl. 330 pages, 171 diagrams. Price 16 reichsmarks.

Among engineers this book is for that group of pioneers whose researches call for computations involving the most advanced mathematical tools. The first edition has been out of print for some years. The new one, thoroughly revised and greatly enlarged, comprises a mass of material in the form of tables, charts and formulas applying to elliptic, Bessel and various other functions, inductance of coils, radiation—to mention only a random few. Text is in both German and English.

NEWS OF THE WEEK

TVA Appropriation Cut to $25,000,000

Savings of $880,978 estimated for customers in Knoxville area. Contracts terminating deal under preparation. To aid coal industry.

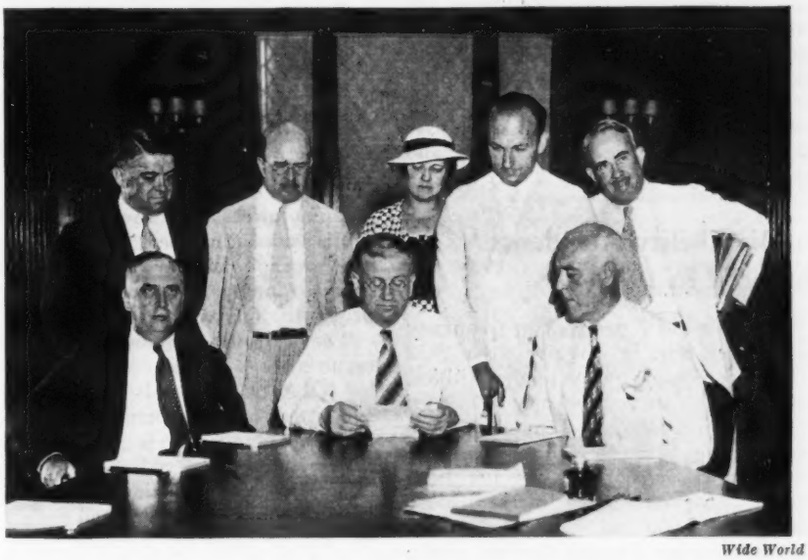
Substantial reduction has recently been effected in the original TVA appropriation voted by Congress when the total fund was slashed from $48,000,000 to $25,000,000, in order that the difference might be allotted to other activities for which sufficient funds were not made available.

Announcement was made last week by the Authority that its acquisition of electric properties in the Knoxville area will result in an annual saving of $880,978 in the community's electric bill. For the entire area the total revenues for 1933 were $2,212,343 for a total consumption of 71,584,000 kw.-hrs. Under the standard TVA rates, the bill for the same consumption will be $1,331,365. "Residential consumers," the announcement said, "will save $374,000 or 50.4 per cent. Commercial users will save $253,000 or 38.5 per cent and industrial users will save $199,000 or 30.6 per cent. For street lighting and other purposes Knox County will save $52,300 a year."

Representatives of the Authority, the National Power & Light Company, the Tennessee Public Service Company and the City of Knoxville have at the present time under discussion the terms of the contract that will terminate the TVA-Tennessee Public Service Company deal (ELECTRICAL WORLD, July 21, page 91). August 8 has been set as the time by which the city must agree to take over the properties and the utility's bondholders must agree to relinquish their bonds at 96½.

In the meantime invitation to the coal industry has been extended by the Tennessee Valley Authority looking toward the active co-operation of coal producers and miners' organizations with the TVA to "find ways and means to expand the uses of bituminous coal." The TVA has been at work seeking to develop new uses for coal, so that the mining area can prosper with the rest of the region," Chairman Morgan said. "There is no question but that in the years to come coal will be so valuable for use in chemical, metal and other manufacturing processes that it will seem a waste and misuse to use our coal resources for power where water power is available. It is the business of the Tennessee Valley Authority to try to combine both these values—to get the undoubted economies and values of water power, and also to work vigorously to develop new and additional uses for coal so that it will be used in constantly larger quantities. . ."

CHARTING THE NEW DEAL'S POWER COURSE



Wide World

Meeting for the first time, President Roosevelt's recently appointed National Power Policy Committee gathers in the office of Secretary of the Interior Ickes. Left to right: (seated) Basil Manly; Harold L. Ickes, chairman of the committee; Robert E. Healy; (standing) Major-General Edward H. Markham, chief of Army Engineers; T. W. Norcross; Miss Mae Schnurr; David E. Lilienthal and Morris L. Cooke. Frank R. McNinch of the Federal Power Commission and Dr. Elwood Mead of the Bureau of Reclamation, the other members of the committee are not shown.

Code Unenforceable, Says G. B. Cortelyou

Consolidated Gas head protests duplicating and mailing code as unfair to public utilities. Other utilities file briefs.

"In all probability, the privately operated companies in the public utility industries could not be compelled to accept or comply with any code under the Recovery Act," states George B. Cortelyou, president of the Consolidated Gas Company, in a brief filed with the National Recovery Administration protesting against the proposed code for the duplicating and mailing industry. As that code is now worded, it would include under its provisions as "private plant members" utilities and other businesses which for their own consumption carry on multigraphing addressographing and other duplicating processes "sufficient to require the equivalent of at least one worker's full time."

"Certainly," Mr. Cortelyou added, "these industries could not be compelled to accept and comply with more than one code or with any code in the submission of which they have not participated and in the membership of which they have no representation."

The Niagara Hudson Power Corporation and its associated companies, and the code committees of the electric light and power industry and the manufactured gas industry also filed briefs protesting the code. The Consolidated brief asserts that addressographing, multigraphing and cognate processes are employed by public utilities in preparation and delivery of bills, in preparing payrolls, payroll envelopes, time cards and other uses. Such uses, the brief declares, are not a business of duplicating and mailing, and the companies are not engaged in such work for profit in competition with outside concerns. Application of the proposed duplicating and mailing code to public utilities would not be effective in increasing wages or re-employment of labor, the brief says.

Cornell Conducts Research in Farm Electrification

In co-operation with leading utilities and electrical manufacturers the New York State College of Agriculture at Cornell University has recently undertaken extensive research work in rural electrification. The projects undertaken include the response of the codling moth to light, a study of electric soil sterilizers, the place of electricity in the farm cooling and handling of eggs, milk house construction and equipment and electric brooding.

Manufacturers, such as the Lyon Electric Company, General Electric Company, Servel Corporation, Folmer Electracide Corporation, Hynes & Cox Electric Corporation and others, are loaning equipment. The utilities, through the Empire State Gas and Electric Association's Farm Electrification Council, have contributed a sum of approximately $6,000 for the conducting of this work. In addition, the Agricultural College is loaning the use of its equipment and personnel.

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Pay Cuts Restored by Two Utilities

In restoring one-third of the wage cut put into effect in 1932, the Commonwealth Edison Company has announced that the restoration, effective August 1, will apply to approximately 15,000 employees. Employees of the Peoples Gas Light & Coke Company and the Public Service Company of Northern Illinois (except officers and higher executives) will also share in the increase.

Approximately 550 of the 800 employees of the Memphis Power & Light Company were given a 5 per cent increase in pay last week. W. J. O'Brien, the company's president, said the increase would restore one-half of a 10 per cent cut made October 1, 1932. Only employees whose salaries were reduced will share in the increase, President O'Brien said.

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P. C. E. A. Reorganizes to Enlarge Its Scope

Reorganization of the Pacific Coast Electrical Association into an all-industry trade association for the states of California, Arizona and Nevada, as well as Hawaii and the Philippine Islands, and the adoption of a program designed to revive interest in association activities has been perfected by newly-elected officers of the organization after several months study. A. H. Markwart, vice-president of Pacific Gas & Electric Company, has been elected president, with F. O. Dolson, vice-president of Southern Sierras Power Company and Charles A. Langlais, San Francisco electrical contractor, as vice-presidents.

Changes in the new organization include broadening of membership classifications, creation of two sections to provide for commercial and technical committee work, and the assumption of certain functions formerly delegated to the Pacific Coast Electrical Bureau which ceased operation last February. No general convention is planned at present but the program calls for two meetings each year for each of the sections. V. W. Hartley has been elected secretary and managing director.

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Public Utility Accidents Reduced in 1933

Reductions of 7 per cent in frequency and 17 per cent in severity from 1932 to 1933 were made by the public utilities, according to a survey recently completed by the National Safety Council. These findings are based on the records of 488 organizations reporting for both years, whose employees worked more than 600,000,000 man-hours per year. This improvement means that the public utilities industry has reduced both rates every year since 1926.

In 1933, electric utilities experienced the first reversal in severity injury rates since 1928. The frequency of disabling injuries decreased 11 per cent from 1932, according to the records of companies reporting both years, but severity rose slightly. Large units lead electric utilities in safety. Frequency rates rose from 6.93 in the largest organizations to 10.67 for middle-sized units, and to 15.70 for the smallest companies; severity rates rank upwards from 1.69 to 4.45.

COMING MEETINGS

Economic Conference of Engineers—Fourth annual meeting, Stevens Institute of Technology Engineering Camp, Johnsonburg, N. J., August 11-19. Harvey N. Davis, Stevens Institute of Technology, Hoboken, N. J.

International Association of Municipal Electricians — Wardman Park Hotel, Washington, D. C., August 29-Sept. 1. W. H. Harth, City Hall, Columbia, S. C.

Producers and Distributors of Electrical Energy—Fifth International Congress, Zurich and Lausanne, Switzerland, August 29-Sept. 7. Secretary, Union des Centrales Suisses d'Electricite, 301 Seefeldstrasse, Zurich.

American Institute of Electrical Engineers—Pacific Coast Convention, Salt Lake City, Utah, September 3-7. General Convention Committee, 1016 Continental Bank Bldg., Salt Lake City, Utah.

Association of Iron and Steel Electrical Engineers—30th convention, held in conjunction with the Iron and Steel Exposition, Cleveland, Ohio, September 18-20. J. F. Kelly, Empire Bldg., Pittsburgh, Pa.

National Electrical Exposition — Madison Square Garden, New York, N. Y., September 19-29. Ralph Neumuller, Electrical Association of New York, Grand Central Palace, New York.

Electrochemical Society — Sixty-sixth convention, Hotel Pennsylvania, New York City, September 27-29. Colin G. Fink, Columbia University, New York.

Illuminating Engineering Society— Annual convention, Baltimore, Md., October 1-4. D. W. Atwater, Secretary, 29 West 39th Street, New York.

. . . THIS WEEK IN WASHINGTON

Greenwood, S. C., $2,767,000 hydro allotment to stand, says Ickes . . . Radio manufacturers seek divorce from N.E.M.A. code at Washington hearing. Code authority severely criticized.

ATTEMPT of Duke Power interests to obtain reconsideration by PWA of a $2,767,000 allotment for Greenwood County, S. C., hydro plant was futile. At the hearing granted by the Power Board of Review Dr. P. W. Few, of Duke University, contended that the project would not be self-liquidating, that it would be a government subsidy to James Self, Greenwood textile manufacturer, and that Duke endowed institutions would suffer. Before departing on his vacation Administrator Ickes announced that the allotment would stand.

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The Radio Manufacturers Association attempted again to blast their industry out of the N.E.M.A. code and in a public hearing this week presented the story of Deputy Allen's insistence early in NRA that they stick with N.E.M.A., and his saying that if after a trial the plan did not work they might request exemption. The manufacturers' brief contained severe criticism of N.E.M.A., whose only service, radio manufacturers said, was "partial work on standards and an unsuccessful attempt to get statistics, and unsuccessful efforts to hold radio shows." They said that code administration would be much less expensive with their own code than under fees assessed by N.E.M.A. In opposition, W. J. Donald, managing director of N.E.M.A., stated that a separate code would produce a "vicious horizontal" setup affecting electrical manufacturing, furniture, metal stamping, screws and molded products industries. Mr. Donald said that the radio manufacturers' case was not comparable to the vacuum cleaner, washing machine and storage battery industries which were granted exemptions with the approval of N.E.M.A. code authority.

The decision on giving the radio manufacturers a separate code will be made by NRA on the basis of the evidence submitted and announced later. The tendency, however, is to make fewer rather than more codes, and elaborate efforts to compose the differences between the manufacturers and the authority will be made by NRA.

PAUL WOOTON,
Washington Correspondent.

Standards of Insulation Adopted at A.S.T.M. Meeting

At the annual meeting of the American Society for Testing Materials, held recently at Atlantic City, methods for determining particle size, apparent density and bulk factor of molding powders used in manufacturing molded electrical insulation were approved as a tentative standard. A water absorption test for rate of absorption has been developed and was recommended for inclusion in the methods of testing laminated round rods used in electrical insulation.

Committee B-4 recommended the adoption as standard of the following tentative specifications covering: Drawn or rolled alloy, 80 per cent nickel, 20 per cent chromium, for electrical heating elements; drawn or rolled alloy, 60 per cent nickel, 15 per cent chromium, and balance iron, for electrical heating elements; method of test for determining the temperature-resistance constants of resistance alloys. This action will be confirmed by letter ballot of the society.

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British Stations to Spend $25,000,000 on New Plants

Extensions and improvements estimated to cost approximately $25,000,000 will be undertaken immediately by British central station owners under plans approved by the British Electricity Commission. The extensions will be made in stations selected by the commission, and are to be made in anticipation of the increased load expected from the new national grid.

The projects sanctioned include the installation of additional generating sets and boiler plants at a number of stations, including Sheffield, Blackburn, Hull, Southampton, Leeds, Bristol, Newport, Norwich, and Liverpool. Chief among the projected expansions will be the enlargement of the Neepsend generating station at Sheffield at an estimated cost of $2,195,000 and the Blackburn Meadows No. 2 station at a cost of $2,110,000.

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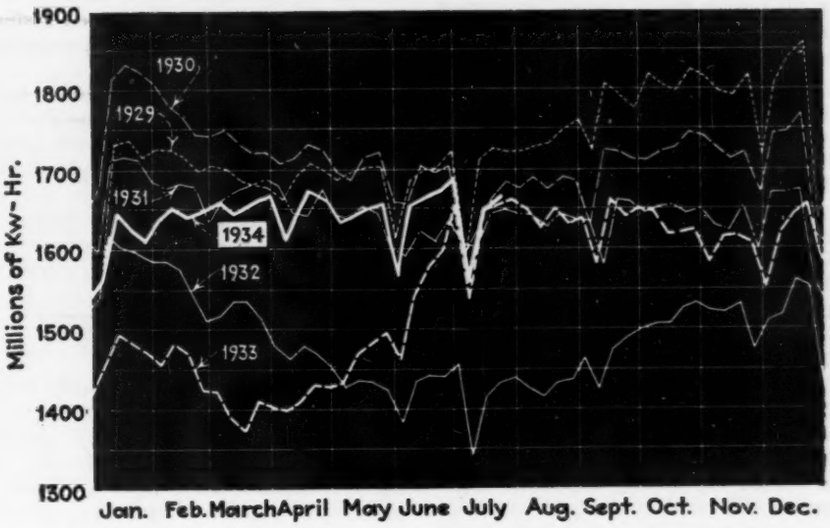
Japan's Energy Use Rise Forecasts National Grid

Since electrical energy consumption in Japan has increased at such a rapid rate due to the industrial revival of the last two years, some general project is necessary to alleviate a possible power shortage, the Department of Commerce reports. In 1933, the department states, energy output amounted to 17,403,000,000 kw.-hr., an increase of 1,642,000,000 kw.-hr. over 1932 and 5,510,785,000 kw.-hr. over 1931.

Energy Output Up 1 per Cent



Output of electrical energy by central stations during the week ended July 21 continued upward, showing an increase of 1 per cent over the preceding week. According to the Edison Electric Institute the total for the interval amounted to 1,663,771,000 kw.-hr., 0.6 per cent above the corresponding period of 1933. A year ago the rapid rise which started in May was just culminating and production was virtually level for several months. In the absence of any marked changes in industrial activity the figures this year may therefore be expected to show little change from those for 1933. Industrial consumption climbed during the first half of the current year and apparently is continuing at the level thus attained.

On the Pacific coast the rise over last year was smaller than in the preceding week, probably due in large part to the tying up of normal activities by the general strike in San Francisco. The increase was 5.1 per cent against 10.5 per cent the week before. In the West Central region the percentage gain over 1933 increased from 0.7 per cent to 4.8 per cent.

Weekly Output, Millions of Kw.-Hr.

1934	1933	1932
July 21... 1,664	July 22... 1,654	July 23... 1,434
July 14... 1,648	July 15... 1,648	July 16... 1,416
July 7... 1,556	July 8... 1,539	July 9... 1,342
June 30... 1,688	July 1... 1,656	July 2... 1,457
June 23... 1,675	June 24... 1,598	June 25... 1,441

Per Cent Change from Previous Year

Region	Week ended July 21	July 14	July 7
New England	− 9.0	− 9.8	−11.3
Middle Atlantic	+ 3.0	+ 2.7	+ 5.8
Central Industrial	− 0.1	− 1.0	− 0.3
West Central	+ 4.8	+ 0.7	+ 1.6
Southern States	+ 1.2	− 4.2	− 4.2
Rocky Mountain	− 2.0	+ 0.2	+ 1.7
Pacific Coast	+ 5.1	+10.5	+11.9
United States	+ 0.6	− 0.0	+ 1.1

A plan for the establishment of a power transmission network covering the entire main island has been drafted by the Electric Power Federation of Japan with the end in view of making cheap power available for domestic industries. The plan calls for construction of new plants, enlarging existing facilities and construction of transmission lines throughout the country.

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Air Markings Required

Transmission lines, causeways, bridges and other structures over navigable waters of the United States are now required to be provided with lights and other signals for the protection of air navigation, the Bureau of Air Commerce announces. Responsibility for installation and maintenance of the lights and signals is charged to owners or operators of the structures.

Pole Standards Advance Line Engineering

General acceptance of the pole specifications of the American Standards Association has placed pole selection and size choice on a better engineering basis, R. E. Meyers, International Creosoting & Construction Company, stated in a paper on the preservative treatment and line service of creosoted poles presented at the recent annual meeting of the American Wood Preservers' Association at Houston, Tex. Mr. Meyers also discussed the widespread use of creosoted pine poles for distribution lines in cities and brought out the insulating value of wood for high-voltage transmission lines, stating that 110-kv. and 132-kv. transmission lines are economically supported on creosoted wood-pole structures.

As to Rates . . .

• United Power & Light Corporation has filed with the Kansas Corporation Commission a new electric lighting schedule which, it is estimated, will save the consumers in more than 100 towns approximately $300,000 a year. The new rate is a reduction of 1 cent in the second step of the residence lighting rate in all but six towns served by the company. For the six towns the reduction is one-half cent. In addition to the rate reduction the company is putting into effect a new penalty scale, abrogating the present 10 per cent penalty if bills are not paid within ten days. The new clause allows the ten days and then if the bill is paid within five additional days a penalty of 2 per cent is charged and if paid within the succeeding ten days the penalty is 5 per cent. After that period the penalty becomes 10 per cent.

• Carolina Power & Light Company has been ordered by the South Carolina Railroad Commission to cut its rates charged South Carolina ginneries by approximately 40 per cent. This utility serves both the Carolinas. This reduction brings the Raleigh utility's rates to the same general level as those charged by the South Carolina Power Company, the Duke Power Company and the Southern Public Utilities Company.

• Central Hudson Gas & Electric Company has reduced its industrial power rates $52,000 annually by order of the state Public Service Commission. Added to prior reductions made between March 1 and May 1 of this year, for the same type of consumer, the latest order means a net saving of more than $118,000.

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Amherst Signs Contract With Ohio Utility

Following a lengthly discussion, the village of Amherst, Ohio, has signed a six-year contract with the Ohio Public Service Company for electric energy and abandoned plans for the construction of a municipal plant.

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P. G. & E. System Sought By Municipal District

Directors of the Sacramento Municipal Utility District, which was recently extended to include practically all of Sacramento and Placer counties in California, have instructed Albert Givan, chief engineer and general manager, to prepare an application to the State Railroad Commission for a valuation of the distribution system of the Pacific Gas & Electric Company in the territory comprising the district. In addition they voted to apply to the federal government for a PWA loan and grant in the amount of $8,500,000 to be used for the purchase of the privately-owned system or for the construction of a competing system.

Last year PWA authorized a loan and grant of $11,700,000 to the district for the construction of the Silver Creek water project, but subsequently withdrew the appropriation when the district turned its attention to the proposed Central Valley Water project as a source of water and hydroelectric power.

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Plant Faces Foreclosure

Suit has been filed in the district court at Dallas, Tex., by the Municipal Acceptance Company of Chicago against the city of Seymour for foreclosure on the municipal electric light and power plant. The petition alleges that the city is indebted to the plaintiff company in the sum of $142,419, including principal and interest, secured by mortgage on the plant. The plant was constructed in 1929 by Fairbanks, Morse & Company.

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Injunction Asked Against Nebraska Plant

Injunction has been asked in the federal court for Nebraska by the Harris Trust Company of Chicago and the United Trust Company of Abilene, Kan., trustees for holders of $600,000 of first mortgage bonds of the Southern Nebraska Power Company, to prevent the construction of a competing municipal plant at Deshler, where the company has an investment of $80,000 in the town and $35,000 in outside construction and connections. Fairbanks, Morse & Company is among the defendants. The company franchise does not expire until 1954. Suit brought by the power company in district court to prevent construction was dismissed.

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Kennett (Mo.) Plan Carried to Federal Court

Suit has been filed in the federal court at Cape Girardeau, Mo., by the Arkansas-Missouri Power Company, which seeks to restrain the city of Kennett from building a municipal electric plant. This project has been involved in court action since voters at an election held last August approved of the city-owned plant. The PWA has allotted the city $150,000. The utility company maintains that the city practiced fraud in connection with statements and representations in a campaign prior to balloting on bonding the city for $140,000 to finance the undertaking.

Municipal Ownership Restrained in Muncie

A permanent injunction restraining the city of Muncie, Ind., from submitting the question of municipal ownership to the voters was issued recently in Superior Court there by Judge Walter S. Bent, sitting as special judge. The city is served with electricity and gas by the Indiana General Service Company. An election, set for last April, was held up by temporary restraining orders. Judge Bent's last action was based on the same theory as his issuance of the temporary restraining orders. He held at that time that the utilities had gained certain rights when they surrendered their franchises for indeterminate contracts; in other words, left the jurisdiction of the city officials under the old franchise system and went under the jurisdiction of the Indiana Public Service Commission.

The court held that the utilities are not affected by the 1933 public service commission act, upon which the election was based. He ruled that the utilities' contract with the city was based on the 1913 law, which stipulated that a city could acquire utility property only in cases where the majority of the property was located inside the city's limits. The 1933 act had removed this limitation.

The injunction not only restrains the city holding the election, but also blocks any other or further steps toward the condemnation, acquisition or operation of utilities by Muncie.

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Colorado Utility Denied Change of Venue

Public Service Company of Colorado has been denied by the state supreme court a writ of prohibition to prevent the Larimer County District Court from trying a condemnation suit against its property in Fort Collins. Attorneys for the company sought for a change of venue on the grounds that public opinion is so strongly in favor of the city's operating a municipal plant that a fair local trial is hardly possible.

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Duke Power to Fight Greenwood Project

In a letter requesting a hearing, G. G. Allen, president of the Duke Power Company, has filed a protest with the Federal Power Commission opposing the construction with Public Works funds of the municipal hydro-electric plant in Greenwood, S. C. (ELECTRICAL WORLD, July 7, page 25). Last week the Public Works Administration cast aside the utility's company objection to its $2,767,000 loan and announced that the money would be available as soon as a bonding contract is completed.

FINANCIAL · · · BUSINESS

D. C. Green Named Middle West Trustee

Federal court orders receivership ended in 5 days. United Public Service and United Public Utilities reorganization plan is announced.

Clearing the way for reorganization of the Middle West Utilities Company under the terms of the amended Bankruptcy Law, Federal Judge James H. Wilkerson this week ordered the Insull holding company lifted from receivership within five days and named Daniel

C. Green as temporary trustee. Mr. Green has been president of the company during the past year of the receivership and has had active charge of operations of the holding company's subsidiaries.

Under the terms of Judge Wilkerson's order a meeting will be held August 17 to determine if Mr. Green shall be made a permanent trustee, or if a different trustee or additional trustees shall be selected. Judge Wilkerson remarked that the appointment of a trustee has the advantage of lifting the company out of receivership costs and will be "in the interests of economy if the reorganization is effected within a short time."

United reorganization

Details of the reorganization of the United Public Service Company and the United Public Utilities Company in connection with petitions filed in the federal court in Chicago recently to reorganize under the national bankruptcy act (ELECTRICAL WORLD, May 5, page 671) have been announced. The plan calls for the formation of two new companies in New Jersey, to be called the United Public Service Corporation and the United Public Utilities Corporation, respectively, to acquire the assets of the present companies.

United Public Service Corporation would be vested with all assets of the United Public Service Company, including collateral held by the Middle West Utilities Company. It would acquire also 148,055 class B common shares of the United Public Utilities Corporation to be issued in exchange for the $1,792,000 demand note of the United Public Utilities Company and common shares of that company held by the United Public Service Company. The latter also would surrender and cancel all preferred stock held in the United Public Utilities Company, including any such preferred held by Middle West Utilities as part of the collateral securing a $5,401,000 note. The United Public Service Corporation would have a single class of stock, to be issued in exchange for present securities of the United Public Service Company.

United Public Utilities Corporation would be vested with the assets of the United Public Utilities Company, including collateral pledged under first lien bonds. The new company would issue its securities as follows in exchange for the old: For each $100 of present A, B and C first lien bonds will be delivered $50 of new convertible collateral trust bonds, ratably secured by the same collateral as present first lien bonds, and one share of new convertible cumulative no par preferred stock and one share of voting class A common stock, represented by a voting trust certificate. Interest accrued on first lien bonds to date when interest began to accrue on collateral trust bonds would be paid in ten-year scrip bearing 5 per cent interest. Holders of 6 per cent (A and C) first lien bonds would receive collateral trust bonds bearing 6 per cent interest and preferred stock carrying annual dividends of $3 a share; holders of 5½ per cent (B) first lien bonds would receive new bonds bearing 5½ per cent interest and preferred stock carrying dividends of $2.75 a year.

DOG DAYS

Generally unanimous, although with scarcely overwhelming significance, business indicators have turned downward. Steel production dropped slightly to 27.7 per cent of capacity from 28.8 per cent the previous week. Carloadings, although recovering from the holiday week drop, are still below the figure for the 1933 week. Bituminous coal production failed to recover sufficiently from the holiday decline to approach its levels of the past two months. Both energy output and automobile production, however, showed slight gains over last week.

Perhaps as a reflection of these disappointing prospects, the serious drought which now involves virtually the whole of the middle-west, and also because of renewed uncertainties regarding government activities and policies in the fall, security markets sagged badly. European news sped the pace. Bonds and commodities participated to a measure. Strike news continues disturbing, but it lacks augmented seriousness. It is not too much to hope that most of the bad news is already out, although overseas developments are of so profoundly disturbing a nature as to make optimistic anticipations almost futile for the time being.

Abitibi Probe Opened By Royal Commission

Investigation by the federal royal commission of the acquisition by the Ontario Hydro-Electric Power Commission of the Ontario Power Service Corporation, known as the Abitibi deal, opened last week in Toronto. Former Premier George S. Henry of Ontario testified regarding steps leading to the final deal which resulted in the Hydro Commission's acquisition of the power company's assets through flotation of an $18,000,000 bond issue involving an exchange of Hydro bonds for those of the company at a ratio of 90 to 100.

Mr. Henry said the Government reached its conclusion that acquisition of the power company's assets should be made on the grounds that it was desirable that the company become publicly-owned. Discussing his bond holdings and those of Senator Meighen, resigned Hydro Commissioner, in the Ontario Power Service Corporation, Mr. Henry stated that at the time the deal was concluded he was unaware that Senator Meighen owned bonds of the acquired company, nor had he informed the Senator of his own holdings.

Associated Gas Plan Gets Bondholders Backing

More than 60,000 holders of $140,000,000 of the funded debt of the Associated Gas & Electric Company have deposited their securities under the plan of rearrangement of the debt launched a year ago. They represent 53 per cent of the entire funded debt of the company, according to the preliminary condensed report for 1933, issued this week. Based on deposits made prior to June 1, the savings resulting from the plan on an annual basis will amount to $2,758,382.

"These interest savings, while substantial, may be insufficient, unless business improvement continues, to prevent a deficit for fixed interest on the debentures of the company during 1934, because of increased outlays for taxes

and for labor and materials," J. I. Mange, president, says in the report.

Consolidated income account of the company and subsidiaries for 1933 shows operating revenues of $81,331,-301, comparing with $84,826,457 for 1932. A deficit of $3,248,124 is recorded after fixed charges in contrast with a net income of $4,309,430 in 1932. Including capital surplus, total surplus on December 31 was $5,540,443, against $17,246,290 a year before. "The absence of a bond or security market, caused largely by the stringent regulations of the securities act, has made it necessary to finance maturing obligations largely out of earnings to the extent that such obligations could not be extended, and this has been a further drain upon the company's cash," Mr. Mange reports.

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Chrysler to Market Air Conditioners

Marketing of Chrysler Motors new air conditioning equipment will be undertaken by the Temperature Corporation, Walter P. Chrysler, Jr., announced last week. Manufactured by the Amplex Manufacturing Company, a Chrysler subsidiary, the unit is known as the Airtemp Conditioner. The unit is of the room type, and its low price is designed to capture the mass market.

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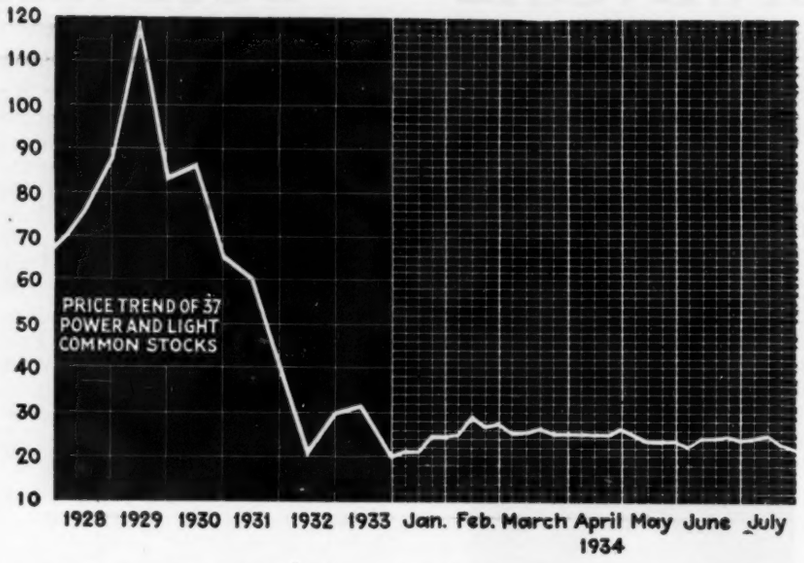
Sioux City Utility Not in Receivership

Sioux City Gas & Electric is not in receivership, as announced in error in the ELECTRICAL WORLD, July 14, but is involved in a dispute concerning the ownership of some of the common stock. W. F. Bertke was not appointed temporary receiver for the company, but temporary receiver for such common shares as are owned by the American Electric Power Corporation. This is an attempt to appoint an Iowa receiver for the affairs of American Electric Power, a Delaware company. There are no assets of this holding company in Iowa, but efforts are being made to create assets by forcing the transfer of shares already in the possession of the federal courts in Delaware, or if not a transfer, a duplicate issue. Such action is apparently already enjoined by the federal courts in Delaware, according to notice filed with the Iowa state court.

Shares Decline Sharply



Stock prices broke sharply this week in the steepest decline since last fall. Utility securities shared in the general losses. *Electrical World* index dropped to 22.2, the lowest point since early January, compared with 22.9 last week.

Kelvinator Earns $1.12 In Second Quarter

For the nine months ended June 30 Kelvinator Corporation reports net profit after depreciation, interest, Federal taxes and other charges, of $1,212,-421, equal to $1.09 a share on 1,108,818 no-par common shares, against $753,-682, or 67 cents a share on 1,124,645 shares in the same nine months of the previous fiscal year.

Net profit for the quarter ended June 30 after same deductions amounted to $1,248,839, or $1.12 a share on 1,108,-818 common shares, compared with

Current Earnings Reports of Electric Light and Power Companies

Operating Companies

	1934	1933	Per Cent Increase	Operating Ratio 1934	Operating Ratio 1933
Arkansas Power & Light (Year ended May 31)					
Gross earnings	$7,118,877	$7,290,785	— 2.0	65	56
Net earnings	2,468,563	3,223,942	— 23.5		
Net balance	383,729*	389,772	—198.0		
Detroit Edison (Year ended June 30)					
Gross earnings	44,147,109	41,645,273	6.0	68	71
Net earnings	14,050,269	12,195,970	15.2		
Net balance	7,382,838	5,573,948	32.2		
Houston Lighting & Power (Year ended May 31)					
Gross earnings	7,989,527	7,799,030	2.0	54	53
Net earnings	3,671,235	3,645,681	0.7		
Net balance	1,985,390	1,957,634	1.4		
Louisville Gas & Electric (Year to May 31)					
Gross earnings	9,764,489	9,527,764	2.5	54	56
Net earnings	4,462,325	4,163,654	7.1		
Net balance	1,327,105	1,188,891	11.7		
Memphis Power & Light (Year ended May 31)					
Gross earnings	6,192,764	6,372,794	— 3.0	72	70
Net earnings	1,713,871	1,867,601	— 8.2		
Net balance	480,520	625,222	— 23.0		
Oklahoma Gas & Electric (Year to May 31)					
Gross earnings	10,701,922	10,431,191	2.6	61	59
Net earnings	4,172,637	4,235,228	— 1.5		
Net balance†	1,770,592	1,827,845	— 3.1		
Puget Sound Power & Light (Year ended May 31)					
Gross earnings	$12,848,395	$12,804,408	0.3	67	6
Net earnings	4,267,550	4,974,102	— 14.2		
Net balance	1,450,213*	248,508*	—483.0		
Virginia Electric & Power (Year ended May 31)					
Gross earnings	14,851,698	14,793,515	0.4	69	64
Net earnings	4,628,936	5,317,191	— 12.9		
Net balance	1,549,030	2,242,159	— 30.8		

Holding Companies

	1934	1933	Per Cent Increase	Operating Ratio 1934	Operating Ratio 1933
Northern States Power (Del.) and subsidiaries (Year ended May 31)					
Gross earnings	$31,521,563	$31,397,380	0.4	63	60
Net balance	5,437,499	6,428,723	— 15.5		
Public Service Corporation of N. J. and subsidiaries (Year ended June 30)					
Gross earnings	119,347,057	119,148,492	0.1	66	65
Net balance†	26,490,316	26,602,058	0.9		

*Deficit. †Available for all dividends.

Gross earnings—(Operating Companies) Gross operating revenue. (Holding Companies) Gross operating revenue plus other income. Net earnings—Earnings after deduction from gross earnings of operating expenses taken to include taxes, depreciation, maintenance, operating, etc. Net balance—Balance available from income for common stock dividends.

$305,517, or 28 cents a share on 1,106,041 shares in preceding quarter and $1,414,564, or $1.25 a share on 1,124,645 shares, in June quarter a year ago. These results do not include earnings of the Refrigeration Discount Corporation, a wholly owned subsidiary, whose profits are customarily taken as a dividend at the close of the fiscal year ended September 30.

With total shipments for the first nine months of its current fiscal year aggregating 195,811 units, refrigerator deliveries of the company are 32 per cent ahead of shipments for the corresponding period of the 1932-33 fiscal year, H. W. Burritt, vice-president in charge of sales, announced this week.

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Pennsylvania R.R. Orders 28 Electric Locomotives

Orders have just been placed by the Pennsylvania Railroad for 28 electric passenger locomotives to cost more than $6,000,000. Part of the fleet of 101 new electric locomotives the railroad will use in inaugurating through electric service between New York and Washington next year. The new engines feature a redesigned cab, in which the engineman's control position is placed in the center instead of at the ends of the cab.

Westinghouse Electric & Manufacturing Company will build 12 of the new locomotives, the General Electric Company five, and the railroad will assemble the other 11, the propulsion equipment for which will be supplied by the two electrical manufacturers.

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Johns-Manville Converts Loss Into Profit

Net profit of the Johns-Manville Corporation and subsidiaries for the six months ended June 30, after taxes, depreciation, depletion and other charges, amounted to $173,855, equivalent after 7 per cent preferred dividends to $2.32 a share on 75,000 no-par common shares, contrasted with net loss of $861,595 in the first half of 1933. For the second quarter net profit totaled $249,936, against net loss of $76,081 in the preceding quarter and net profit of $92,204 in the second quarter a year ago.

New York Metal Prices

	July 17, 1934 Cents per Pound	July 24, 1934 Cents per Pound
Copper, electrolytic	9.00*	9.00*
Lead, Am. S. & R. price	3.75	3.85
Antimony	8.20	8.20
Nickel ingot	35.00	35.00
Zinc, spot	4.65	4.65
Tin Straits	51.875	51.95
Aluminum, 99 per cent.	23.30	23.30

*Blue Eagle.

SALES OPPORTUNITIES IN NEW CONSTRUCTION

Spot coverage of the week. Projects approved and proposed, bids requested, equipment wanted, funds available. Prospects for the electrical manufacturer.

South Amboy, N. J.—American Agricultural Chemical Company, New York, N. Y., plans installation of electric furnaces and accessories, motors and controls, regulators, conveyors and other equipment in new agricultural phosphate plant at South Amboy. Plant will be completely electrified, using central station service from Jersey Central Power & Light Company. Cost about $250,000.

New Ulm, Minn.—Asks bids until August 7 for ornamental street-lighting system, including standards, standard units, cable, etc. Carl W. Frank, city engineer.

Lodi, Calif.—Roma Wine Company plans new multi-story distilling plant. Cost about $85,000.

Washington, D. C.—Bureau of Yards and Docks, Navy Department, asks bids (no closing date stated) for electrical distribution system at navy yard, Pearl Harbor, T. H. (Specification 7604).

Knoxville, Tenn.—Tennessee Valley Authority has authorized initial surveys for proposed power dam and hydroelectric power development on Hiawassee River, vicinity of Murphy, Cherokee County, N. C., to include transmission lines, switching stations, power substations and other facilities, including flood control construction. Fund of about $13,000,000 will be used for project.

Mount Holly, N. J.—Public Service Electric & Gas Company, Newark, N. J., plans new underground conduit system on Main and Mill Streets, replacing overhead lines.

Lockport, Ill.—Sanitary District of Chicago, Ill., asks bids until August 7 for hydroelectric power units and accessory equipment for power plant at Lockport, including two 8,500-hp. automatic adjustable blade turbines, with oil pressure governors, pumps, etc.; two 220-hp. Francis type turbines with complete accessories; two 7,500-kva., a.c., 6,000-volt, three-phase, 60-cycle electric generators, with brakes, jacks, field rheostats and complete accessories; two 150-kw., d.c., 250-volt electric generators, with auxiliary equipment. (Fund of $750,000 has been arranged through Federal aid for extensions and improvements in power plant.)

Grand Rapids, Mich.—Dutch Brewing Company plans new multi-story addition. Cost about $150,000. Proposed to ask bids in August.

Kansas City, Mo.—United States Engineer Office asks bids until August 3 for two current-measuring sets, four transformers, two voltmeters, two insulator testers, one testing meter and other electrical measuring instruments (Circular 18).

Greenville, Pa.—Greenville Steel Car Company plans installation of motors and controls, conveyors, etc., in connection with rebuilding of portion of railway car plant.

Brooklyn, N. Y.—Allied Brewing & Distilling company plans purchase of equipment for distilling plant at Frankfort, Ky., and for other distilleries and breweries. Financing for $2,200,000 is being arranged, considerable portion of fund to be used for plant expansion and improvements.

Menominee, Mich.—Plans new city-owned electric light and power plant. Fund of $803,000 has been secured through Federal aid. T. R. Hasley, city engineer, in charge.

San Diego, Calif.—Bureau of Yards and Docks, Navy Department, Washington, D. C., asks bids until August 22 for electrical distribution system at Naval Operating Base, Air Station, San Diego, including ducts, cables, etc. (Specification 7425).

Danville, Va.—Water, Gas and Electric Department, E. C. Brantly, manager, asks bids until August 6 for extensions in city-owned electrical distribution system. Financing has been arranged through Federal aid.

Cincinnati, Ohio—Andrew Jergens Company plans installation of motors and controls, conveyors, mechanical dryers and other equipment in new multi-story addition to soap plant. Cost over $300,000.

Crown Point, Ind.—Board of Public Works asks bids until August 4 for Diesel engine-generating unit and accessory equipment, motor-driven pumping machinery, controls, etc., in connection with new water purification plant. Charles Brossman. Chamber of Commerce Building, Indianapolis, Ind., is engineer.

Detroit, Mich.—Briggs Manufacturing Company plans installation of motors and controls, conveyors, etc., in new addition to pressed steel plant. Cost over $100,000.

Rockford, Iowa—Asks bids until August 6 for Diesel engine-generating unit and accessories, switchboard, instruments, etc., for city-owned electric light and power station. Fund of $82,100 has been arranged. H. L. Cory Company, Redick Tower Building, Omaha, Neb., consulting engineer.

Cleveland, Ohio—Cleveland Railway Company soon takes bids for new power substation on Riverside Drive. Cost about $50,000.

Seattle, Wash.—Century Brewing Company, Airport Way, plans early call for bids for new addition to brewing plant. Cost about $100,000.

Louisville, Ky.—Churchill Downs Distillery Company, care of L. V. Abbott, 8 Kenwood Village, Louisville, architect, approved plans for new multi-unit distillery in Churchill Downs district. Cost about $175,000.

Tecumseh, Mich.—Plans new city-owned electric light and power plant. Fund of $166,000 is being secured through Federal aid.

Minneapolis, Minn.—Hiawatha Brewing Company plans extensions and improvements with installation of new equipment. Financing for $200,000 is being arranged, majority of fund to be used for purpose noted.

MEN OF THE INDUSTRY

A. H. Markwart Heads Pacific Coast Association

ARTHUR H. MARKWART, vice-president of the Pacific Gas & Electric Company in charge of engineering, has been elected president of the Pacific Coast Electrical Association. For more than twenty-five years Mr. Markwart has engaged in engineering practice, encountering and solving problems in construction, finance and organization. He has been identified with Pacific Gas & Electric since 1920 when he was appointed director of engineering, organizing a new engineering department and investigating and designing elements in the rapidly growing system.

His first important connection in the public utility industry was with the old California Gas & Electric Corporation, one of the predecessors of Pacific Gas & Electric organization. His position involved the design and construction of various structures and power plant installations. In 1906 his activity shifted

somewhat from technical engineering to management and engineering investigation, when he became chief engineer and manager of the Syndicate Water Company of Oakland and vice-president and manager of the Richmond Water Company. In 1906 he joined Howard and Galloway, architects and engineers, and subsequently spent four years in general civil engineering practice in San Francisco as a member of Galloway and Markwart, consulting engineers, designing and constructing hydro-electric plants, irrigation systems, buildings and bridges. With the launching of the plans for the Panama Pacific International Exposition in 1912, Mr. Markwart was named assistant director of works and chief of construction for that huge project. Upon the completion of this commission in 1915 he returned to general civil engineering practice. Following the outbreak of the World War, he became closely affiliated with the shipbuilding industry on the Pacific Coast. His connection with the Pacific Gas & Electric Company followed in 1920.

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JACK G. HOLTZCLAW, president of the Virginia Electric & Power Company, has been named chairman of the advisory committee on loans to industry for the Fifth Federal Reserve District.

E. F. SCATTERGOOD, chief electrical engineer and general manager of the Los Angeles Bureau of Power and Light, has been named the first national chairman of the newly organized National Municipal Utilities Association.

D. C. VAN HORNE has been appointed as specialist in charge of commercial refrigeration for the British Columbia territory of the Canadian General Electric Company. Mr. Van Horne began his career in the electrical industry in Hamilton, Ont. He returned to his native province, British Columbia, to assist in several important electrical installations and then entered the service of the General Electric Company in Los Angeles, where he remained for several years. He is an authority on commercial refrigeration and air-conditioning equipment and has directed the installations of large units in California.

PEARL GRAY has been appointed director of range home economics of the Westinghouse Electric & Manufacturing Company. Miss Gray's extensive experience in the home economics field has included connections with the Niagara Hudson Power Corporation and the Peoples Natural Gas Company in Pittsburgh.

H. L. BARGION, formerly manager of the Spokane branch of the Westinghouse Electric Supply Company, has been appointed manager at Seattle to succeed the late Philip J. Aaron. Mr. Bargion has been with the company and its predecessor organizations for the past 25 years, having originally been associated with the Washington Electric Supply Company, one of the early predecessors of the present organization.

KENNETH WILLIAMS has been appointed manager of sales for the department of engineering and construction of Byllesby Engineering & Management Corporation. The engineering department of the Byllesby corporation, which has for some years practically confined its services to the subsidiaries of Standard Gas & Electric Company, is expanding its activities to include general engineering practice for independent clients. It is in this phase of the corporation's activities that Mr. Williams will be associated. For a number of years Mr. Williams has engaged in sales and engineering work in the Middle West and has familiarized himself with many industrial and utility plants in that territory.

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L. R. Coffin Elected Head Of Northwest Power Group

LESLIE R. COFFIN, vice-president of the Puget Sound Power & Light Company in charge of operations, was elected president of the Northwest Electric Light & Power Association at the annual meeting held recently in Portland. Mr. Coffin has spent many years with

the Stone & Webster interests. He was manager of the Puget Sound Company's central district in Seattle before assuming the duties of vice-president three years ago. Previously he had served as manager of the company's eastern district and manager of the Washington Electric Company at Wenatchee.

Prior to the war Mr. Coffin was located at Bellingham in the capacity of manager of the utility's northern district. He left that position to join the Hog Island shipyard organization at Philadelphia. After the war he went to California with Stone & Webster and then started his own business, subsequently returning to the service of the Puget Sound Power & Light Company.

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JAMES T. ADAMS has joined Struthers Dunn, Inc., Philadelphia, in the capacity of sales correspondent to assist in handling engineering problems. A graduate of the Massachusetts Institute of Technology, Mr. Adams was formerly connected with the General Electric Company.

L. F. A. MITCHELL has been appointed assistant sales manager of the Canadian Westinghouse Company, Hamilton, Ont. Mr. Mitchell has had a wide experience in industrial motor and control applications and it is to the promotion of this equipment that Mr. Mitchell will largely devote his attention.

OBITUARY

William H. Bassett

William H. Bassett, metallurgical manager of the American Brass Company and president of the American Society for Testing Materials, died suddenly July 21 at his home in Cheshire, Conn. He was 66 years of age. A pioneer metallurgist in the brass industry, Mr. Bassett was nationally known for his contributions to that branch of the industry. A native of New Bedford, Mass., and a graduate of the Massachusetts Institute of Technology, he became chief chemist and metallurgist of the American Brass Company. From 1912 to 1930 he was technical superintendent and metallurgist, and since 1930 he had been metallurgical manager.

In 1925 Mr. Bassett was awarded the James Douglas Medal for research in copper and brass and other non-ferrous metals and their alloys and for his contributions to the establishment of high standards of quality. He was a director and former president (1930) of the American Institute of Mining and Metallurgical Engineers, a member of the American Institute of Chemical Engineers, Society of Automotive Engineers, Franklin Institute and the British Institute of Metals and Society of Chemical Industries.

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CARL E. GRUNSKY, consulting engineer of San Francisco and past president of the American Engineering Council, died recently in that city at the age of 79. Mr. Grunsky started his engineering career with the California State Engineering Department. He entered private practice in Sacramento in 1886, subsequently moving to San Francisco. He was elected city engineer in 1900 and laid the original plans for the Hetch Hetchy water supply system. In 1914 he was appointed to the First Isthmian Canal Commission by President Theodore Roosevelt. As a consulting engineer he was advisor on many of the irrigation and water developments of California. Mr. Grunsky was a past-president of the American Society of Civil Engineers and for 25 years was president of the California Academy of Sciences.

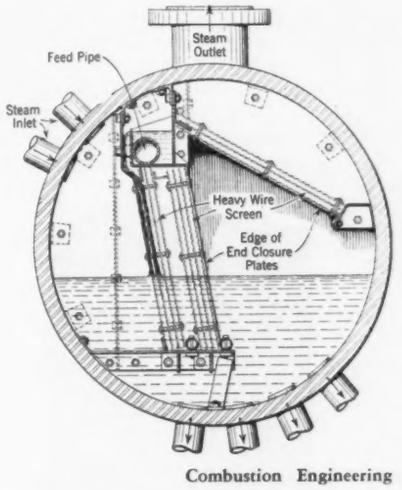
ADOLPH STRAUCH, dean of the electric heating industry in California, died at his home in Oakland, July 21, after a long illness. He was 60 years of age. Mr. Strauch first became identified with electric heating in California when he joined the Mt. Whitney Power & Light Company at Visalia, remaining with that utility until twenty years ago. Later he joined the Pacific Gas & Electric Company in San Francisco, introducing electric cooking and heating and initiating the present type of inducement step domestic rate. For the past ten years he has been in charge of the engineering department for Wesix, Inc., San Francisco. When the Electric Heating Society was formed he was an active influence in it and became its president. He served continuously on the Pacific Coast Electrical Association committees since 1916, contributing data for electric heating handbooks.

FRANK BATCHELOR, mechanical engineer, who worked under Thomas Edison, died July 17 at his home in Irvington, N. J., in his sixty-seventh year. Born in England, Mr. Batchelor came to this country as a youth and associated himself with Charles Batchelor, his uncle, who was the partner of Mr. Edison in the ownership of the incandescent lamp patents. Mr. Batchelor worked under his uncle and Mr. Edison at the iron ore concentrating works in New Jersey and later joined in the development of the belt conveyor. For 37 years he was associated with the Robins Conveying Belt Company.

NEW EQUIPMENT

Steam Washer Placed Within Steam Drums

Steam washers for placing within steam drums have been developed by the Combustion Engineering Company, New York. Water from the feed box spreads over the initial screen and forms a curtain through which the steam must pass on its way to the outlet at the top of the drum. This washes the steam with the clean feedwater and removes much of the solid content. The subsequent screens through which the steam must pass are for the purpose of removing entrained water.



Combustion Engineering

The heavy wire screen sections are made up in panels that can be passed through the drum-head manholes. All except the overhead screens ahead of the steam outlet are assembled and secured in place without the use of bolts or use of tools. Carry-over of solids in the steam has been experienced with boilers operating at around 400 lb. pressure. By washing the steam with fresh feedwater it is possible to reduce the solid carry-over to approximately 1 per cent of the solid content of the incoming boiler feedwater.

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Single-Conductor Series Street-Lighting Cable

Single-conductor series street-lighting cable embodying a "Thiokol" sheath has been announced by the General Cable Corporation, Perth Amboy, N. J. The Thiokol compound is applied directly over the rubber insulation and vulcanized thereto, protecting it from conditions which would cause normal rubber compounds to be short-lived. A single wrap of double-faced rubberized tape and a wrap of fibrous armor coated with pitch-mica finish completes the construction for voltages up to 3,000.

For voltages above 3,000 the design is modified to give additional protection against static cutting and discharges from the outside coverings to the duct construction consisting of a graphitic tape over the Thiokol sheath with two No. 20 A.W.G. tinned copper drain wires applied over same with a short lay, then fibrous armor, asbestos base calk and duck tape with a pitch-mica finish.

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IDEAL COMBINATION TEST-LITE AND FUSE PULLER made of reinforced bakelite and like a pair of pliers, for testing, removing or inserting fuses from 30 to 100 amp. capacity, testing circuits of from 110 to 550 volts, handling all types

of live electrical parts, adjusting loose cut-out clips, etc., has been announced by the Ideal Commutator Dresser Company, Sycamore, Ill. Test pins are mounted on handle ends, opening or closing handle adjusts pins to proper distance.

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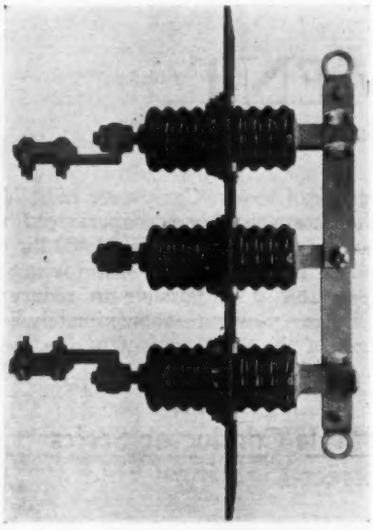
7.5-Kv. Transfer Selector Disconnecting Switch

Double-blade, 7.5-kv., 400-amp. transfer selector disconnecting switches, with each blade and the stud of 400-amp. rating, have been announced by the Delta-Star Electric Company, Chicago. These switches are of tongue-type, full-floating blade construction,



Delta-Star Electric

each blade half floating independently and permitting a wide range of adjustments. The steel mounting base is slotted between the points where the back-conected porcelain studs are located, thus slotting of mounting base reduces inductive heating.

Porcelains are held in position by removable clamps, permitting quick and easy replacement, and have a 60-cycle flashover value to the mounting base of 45 kv.

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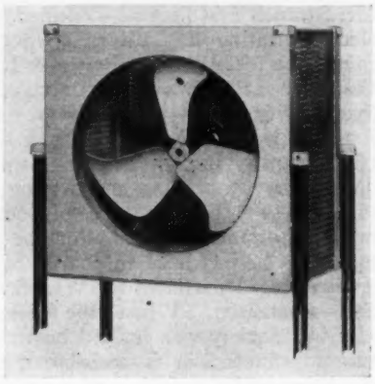
Air Circulator for Summer Comfort

Designed primarily for installation in the attics of homes for circulating air through the attic during the daytime and for drawing the relatively cool outside air through the living quarters toward the end of the day and during the evening, the type HV-1 air circulator, consisting of a rubber cushion-mounted motor directly driving an 18-in., three-blade, aphonic-pressure-type propeller fan which is quiet in operation and assembled in a sturdy metal cabinet, has been announced by the General Electric Company. The fan



General Electric

operates at 860 r.p.m. and delivers 2,050 to 2,600 cu.ft. of air per minute, depending on the back pressure.

The air circulator is available with either a.c. or d.c. motor, as required, and the automatic time switch, available as an accessory, can be set for any period up to ten hours.

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Photoelectric Relay Operates on 1 Ft.-Candle

Photoelectric relay capable of operating on changes in illumination as small as 1 ft.-candle or less, and when used in conjunction with the G-M No. 1217 light source can be operated at distances as great as 90 ft. with white light and up to 40 ft. with an infra-red invisible beam, has been announced by the G-M Laboratories, Inc., Chicago. It operates on 110-volt, 60 cycle a.c. and is normally supplied with contacts having 2 amp. a.c. non-inductive load

G-M Laboratories

capacity. A speed of 600 operations per minute can be consistently maintained. The circuit can be so arranged that no plate current is drawn from the amplifier tube except while the light beam is interrupted, thus increasing the life of the amplifier tube.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogues now available to engineers by manufacturers and associations.

Jeffery-Dewitt Insulator Company, of Kenova, W. Va., have put out sections 5 and 6 of their catalogue in the form of a 24-page booklet entitled "J-D Pin Type Insulators and Pins." Dimensions and design characteristics of some 18 styles of 5 to 66 kv. insulators and their pins are included.

"Johns-Manville Packings," a 48-page catalogue describes the characteristics and recommended applications of 60 packings made by Johns-Manville, 22 East 40th Street, New York. Sizes, weights and prices are also listed.

"It's in the Air," air conditioning 32-page bulletin (SL-115) of General Electric Company, Schenectady, N. Y., describes applications of equipment along with sizes and ratings. There are several house diagrams showing characteristic methods of system installation.

"Distribution Cutouts," a new 16-page booklet, gives the structural details, specifications and characteristics of these products of Porcelain Products, Inc., of Parkersburg, W. Va. Fuse characteristics are graphed, the links described and hangers detailed.

Benjamin Electric Manufacturing Company, Des Plaines, Ill., have just added to their data sheet a group which show how to light softball fields, tennis courts, swimming pools, dog-race tracks, etc. In the BM series they are numbered, respectively, 21E:03, 21G:03-5, 21H:01, 21J:01 and 21D:01.

"Type LE Photo Relay" (43-950) and **"Type SG Auxiliary Relay"** (41-350) are two new 4-page bulletins describing respective details of the industrial electric eye and a versatile relay for opening or closing two independent circuits. Westinghouse Electric & Mfg. Co.

A new leaflet (20,619) of Westinghouse describes the operation principle and applications of "Electric Contactor Timers for Spot Welding."

"A Better Portable Compressor" of Ingersoll-Rand Company, New York, is an 8-page bulletin (2,100) on the details of the two-stage, air-cooled portable compressor built in five sizes from 75 to 370 c.f.m. displacement. Powered with oil or gasoline engine it can be towed as a 35 m.p.h. trailer.

"Stanley Electric Tools" gives capabilities of electric drills, saws, grinders, hammers and shears. It is Stanley Electric Tool Company's (New Britain, Conn.) 46-page catalogue No. 64.

"Here's Proof—That Power Factor Improvement Reduces Power Costs" in its 14 pages tells succinctly how much the savings were in 16 specific cases. It is GES-1012 of General Electric Company, Schenectady, N. Y.

"Proof That Better Street Lighting Saves Lives" assembles in its 8 pages facts about traffic accident statistics that have appeared in print. General Electric calls the booklet number 3010.